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LANGLEY'S AERODROME NO. 5, IN FLIGHT MAY 6, 1896.

FROM INSTANTANEOUS PHOTOGRAPH BY A. GRAHAM BELL, ESQ.

[Concluded from SUPPLEMENT No. 1404, page 22495.]

THE LANGLEY AERODROME.*

Now, in all ordinary construction, as in building a steamboat or a house, engineers have what they call a factor of safety. An iron column, for instance, will be made strong enough to hold five or ten times the weight that is ever going to be put upon it, but if we try anything of the kind here the construction will be too heavy to fly. Everything in the work has got to be so light as to be on the edge of breaking down and disaster, and when the breakdown comes all we can do is to find what is the weakest part and make that part stronger; and in this way work went on, week by week and month by month, constantly altering the form of construction so as to strengthen the weakest parts, until, to abridge a story which extended over years, it was finally brought nearly to the shape it is now, where the completed mechanism, furnishing over a horse power, weighs collectively something less than 7 pounds. This does not include water, the amount of which depends on how long we are to run; but the whole thing, as now constructed, boiler, fire grate, and all that is required to turn out an actual horse power and more, weighs something less than one one-hundredth part of what the horse himself does. I am here anticipating; but after these first three years something not greatly inferior to this was already reached, and so long ago as that, there had accordingly been secured mechanical power to fly, if that were all—but it is not all.

After that came years more of delay arising from other causes, and I can hardly repeat the long story of subsequent disappointment, which commenced with the first attempts at actual flight.

Mechanical power to fly was, as I say, obtained three years ago; the machine could lift itself if it ran along a railroad track, and it might seem as though, when it could lift itself, the problem was solved. I knew that it was far from solved, but felt that the point was reached where an attempt at actual free flight should be made, though the anticipated difficulties of this were of quite another order than those experienced in shop construction. It is enough to look up at the gulls or buzzards soaring overhead, and to watch the incessant rocking and balancing which accompanies their gliding motion, to apprehend that they find something more than mere strength of wing necessary, and that the machine would have need of something more than mechanical power, though what this something was was not clear. It looked as though it might need a power like instinctive adaptation to the varying needs of each moment, something that even an intelligent steersman on board could hardly supply, but to find what this was a trial had to be made. The first difficulty seemed to be to make the initial flight in such conditions that the machine would not wreck itself at the outset in its descent, and the first question was where to attempt to make the flight.

It became clear, without much thought, that since the machine was at first unprovided with any means to save it from breakage on striking against the ground, it would be well in the initial stage of the experiment not to have it light on the ground at all, but on the water. As it was probable that while skill in launching was being gained, and until after practice had been perfect, failures would occur, and as it was not desired to make any public exhibition of these, a great many places were examined along the shores of the Potomac and on its high bluffs which were condemned partly for their publicity, but partly for another reason. In the course of my experiments I had found out, among the infinite things pertaining to this problem, that the machine must begin to fly in the face of the wind and just in the opposite way to a ship, which begins its voyage with the wind behind it.

If the reader has ever noticed a soaring bird get upon the wing he will see that it does so with the breeze against it, and thus whenever the aërodrome is cast into the air it must face a wind which may happen to blow from the north, south, east, or west, and we had better not make the launching station a place like the bank of a river, where it can go only one way. It was necessary, then, to send it from something which could be turned in any direction, and taking this need in connection with the desirability that at first the airship should light in the water, there came at last the idea (which seems obvious enough when it it stated) of getting some kind of a barge or boat and building a small structure upon it which could house the aërodrome when not in use, and from whose flat roof it could be launched in any direction. Means for this were limited, but a little "scow" was procured, and on it was built a primitive sort of a house, one story high, and on the house a platform about 10 feet higher, so that the top of the platform was about 20 feet from the water, and this was to be the place of the launch. This boat it was found necessary to take down the river as much as 30 miles from Washington, where I then was—since no suitable place could be found nearer—to an island having a stretch of quiet water between it and the main shore; and here the first experiments in attempted flight developed difficulties of a new kind—difficulties which were partly anticipated, but which nobody would probably have conjectured would be of their actually formidable character, which was such as for a long time to prevent any trial being made at all. They arose partly out of the fact that even such a flying machine as a soaring bird has to get up an artificial speed before it is on the wing. Some soaring birds do this by an initial run upon the ground, and even under the most urgent pressure can not fly without it.

Take the following graphic description of the commencement of an eagle's flight (the writer was in Egypt, and the "sandy soil" was that of the banks of the Nile):

"An approach to within 80 yards aroused the king of birds from his apathy. He partly opened his enormous wings, but stirs not yet from his station. On gaining a few feet more he begins to *walk* away with half-expanded, but motionless, wings. Now for the chance. Fire! A charge of No. 3 from eleven bore rattles audibly but ineffectively upon his densely feathered body; his walk increases to a run, he gathers speed with his slowly waving wings, and eventually leaves the ground. Rising at a gradual inclination, he mounts aloft and sails majestically away to his place of refuge in the Libyan range, distant at least five miles from where he rose. Some fragments of feathers denoted the spot where the shot had struck him. The marks of his claws were traceable in the sandy soil, as, at first with firm and decided digs, he forced his way; but as he lightened his body and increased his speed with the aid of his wings, the imprints of his talons gradually merged into long scratches. The measured distance from the point where these vanished to the place where he had stood proved that with all the stimulus that the shot must have given to his exertions he had been compelled to run full 20 yards before he could raise himself from the earth."

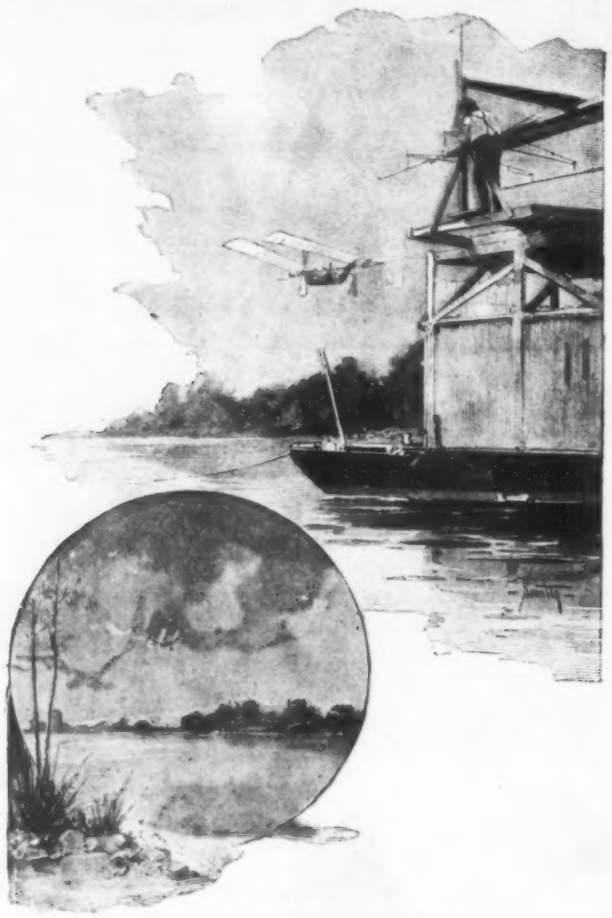
We have not all had a chance to see this striking illustration of the necessity of getting up a preliminary speed before soaring, but many of us have disturbed wild ducks on the water and noticed them run along it, flapping their wings for some distance to get velocity before they can fly, and the necessity of the initial velocity is at least as great with our flying machine as it is with a bird.

To get up this preliminary speed many plans were proposed, one of which was to put the aërodrome on the deck of a steamboat, and go faster and faster until the head wind lifted it off the deck. This sounds reasonable, but is absolutely impracticable, for when the aërodrome is set up anywhere in the open air we find that the very slightest wind will turn it over, unless it is firmly held. The whole must be in motion, but in motion from something to which it is held till that critical instant when it is set free as it springs into the air.

The house boat was fitted with an apparatus for launching the aërodrome with a certain initial velocity, and was (in 1893) taken down the river and moored in the stretch of quiet water I have mentioned; and it was here that the first trials at launching were made, under the difficulties to which I have alluded.

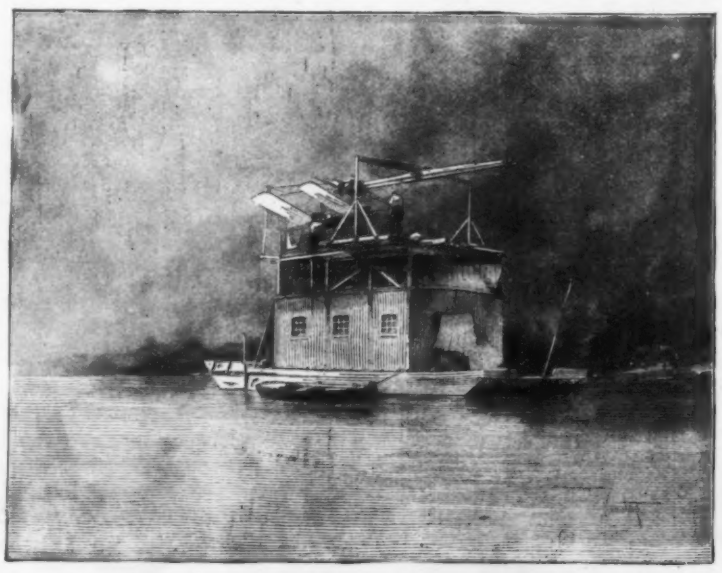
Perhaps the reader will take patience to hear an abstract of a part of the diary of these trials, which commenced with a small aërodrome which had finally been built to weigh only about 10 pounds, which had an engine of not quite one-half horse power, and which could lift much more than was theoretically necessary to enable it to fly. The exact construction of this early aërodrome is unimportant, as it was replaced later by an improved one, of which a drawing is given, but it was the first outcome of the series of experiments which had occupied three years, though the disposition of its supporting surfaces, which should cause it to be properly balanced in the air and neither fly up nor down, had yet to be ascertained by trial.

What must still precede this trial was the provision of the apparatus for launching it into the air. It is a difficult thing to launch a ship, although gravity keeps it down upon the ways, but the problem here is that of launching a kind of ship which is as ready to go up into the air like a balloon as to go off sideways,



THE AERODROME IN FLIGHT. MAY 6, 1896.

Two views from instantaneous photographs taken by A. Graham Bell, Esq.



PREPARING TO LAUNCH THE AERODROME.

From a photograph by A. Graham Bell, Esq.

* From the Smithsonian Report for 1900.

and readier to do either than to go straight forward, as it is wanted to do, for though there is no gas in the flying machine, its great extent of wing surface renders it something like an albatross on a ship's deck—the most unmanageable and helpless of creatures until it is in its proper element.

If there were an absolute calm, which never really happens, it would still be impracticable to launch it as a ship is launched, because the wind made by running it along would get under the wings and turn it over. But there is always more or less wind, and even the gentlest breeze was afterward found to make the air ship unmanageable unless it was absolutely clamped down to whatever served to launch it, and when it was thus firmly clamped, as it must be at several distinct points, it was necessary that it should be released simultaneously at all these at the one critical instant that it was leaping into the air. This is another difficult condition, but that it is an indispensable one may be inferred from what has been said. In the first form of launching piece this initial velocity was sought to be attained by a spring, which threw forward the supporting frame on which the aërodrome rested; but at this time the extreme susceptibility of the whole construction to injury from the wind and the need of protecting it from even the gentlest breeze had not been appreciated by experience. On November 18, 1893, the aërodrome had been taken down the river, and the whole day was spent in waiting for a calm, as the machine could not be held in position for launching for two seconds in the lightest breeze. The party returned to Washington and came down again on the 20th, and although it seemed that there was scarcely any movement in the air, what little remained was enough to make it impossible to maintain the aërodrome in position. It was let go, notwithstanding, and a portion struck against the edge of the launching piece, and all fell into the water before it had an opportunity to fly.

On the 24th another trip was made and another day spent ineffectively on account of the wind. On the 27th there was a similar experience, and here four days and four (round-trip) journeys of 60 miles each had been spent without a single result. This may seem to be a trial of patience, but it was repeated in December, when five fruitless trips were made, and thus nine such trips were made in these two months and but once was the aërodrome even attempted to be launched, and this attempt was attended with disaster. The principal cause lay, as I have said, in the unrecognized amount of difficulty introduced even by the very smallest wind, as a breeze of 3 or 4 miles an hour, hardly preceptible to the face, was enough to keep the airship from resting in place for the critical seconds preceding the launching.

If we remember that this is all irrespective of the fitness of the launching piece itself, which at first did not get even a chance for trial, some of the difficulties may be better understood; and there were many others.

During most of the year of 1894 there was the same record of defeat. Five more trial trips were made in the spring and summer, during which various forms of launching apparatus were tried with varied forms of disaster. Then it was sought to hold the aërodrome out over the water and let it drop from the greatest attainable height, with the hope that it might acquire the requisite speed of advance before the water was reached. It will hardly be anticipated that it was found impracticable at first to simply let it drop without something going wrong, but so it was, and it soon became evident that even were this not the case a far greater time of fall was requisite for this method than that at command. The result was that in all these eleven months the aërodrome had not been launched, owing to difficulties which seem so slight that one who has not experienced them may wonder at the trouble they caused.

Finally, in October, 1894, an entirely new launching apparatus was completed, which embodied the dozen or more requisites, the need for which had been independently proved in this long process of trial and error. Among these was the primary one that it was capable of sending the aërodrome off at the requisite initial speed, in the face of a wind from whichever quarter it blew, and it had many more facilities which practice had proved indispensable.

This new launching piece did its work in this respect effectively, and subsequent disaster was, at any rate, not due to it. But now a new series of failures took place, which could not be attributed to any defect of the launching apparatus, but to a cause which was at first obscure, for sometimes the aërodrome, when successfully launched would dash down forward and into the water, and sometimes (under apparently identically like conditions) would sweep almost vertically upward in the air and fall back, thus behaving in entirely opposite ways, although the circumstances of flight seemed to be the same. The cause of this class of failure was finally found in the fact that as soon as the whole was upborne by the air, the wings yielded under the pressure which supported them, and were momentarily distorted from the form designed and which they appeared to possess. "Momentarily," but enough to cause the wind to catch the top, directing the flight downward, or under them, directing it upward, and to wreck the experiment. When the cause of the difficulty was found, the cure was not easy, for it was necessary to make these great sustaining surfaces rigid so that they could not bend, and to do this without making them heavy, since weight was still the enemy; and nearly a year passed in these experiments.

Has the reader enough of this tale of disaster? If so, he may be spared the account of what went on in the same way. Launch after launch was successively made. The wings were finally, and after infinite practice and labor, made at once light enough and strong enough to do the work, and now in the long struggle the way had been fought up to the face of the final difficulty, in which nearly a year more passed, for the all-important difficulty of balancing the aërodrome was now reached, where it could be discriminated from other preliminary ones, which have been alluded to, and which at first obscured it. If the reader will look at the hawk or any soaring bird, he will see that as it sails through the air without flapping the wing, there are hardly two consecutive seconds of its flight in which it is not swaying a little from side to side, lifting one wing or the other, or turning in a way that suggests an acrobat on a tight rope, only that the bird uses its widely outstretched wings in place of the pole.

There is something, then, which is difficult even for the bird in this act of balancing. In fact, he is sailing so close to the wind in order to fly at all that if he dips his head but the least he will catch the wind on the top of his wing and fall, as I have seen gulls do, when they have literally tumbled toward the water before they could recover themselves.

Besides this, there must be some provision for guarding against the incessant, irregular currents of the wind, for the wind as a whole—and this is a point of prime importance—is not a thing moving along all of a piece, like water in the Gulf Stream. Far from it. The wind, when we come to study it, as we have to

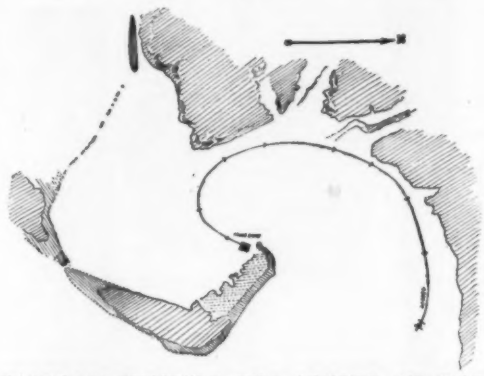


DIAGRAM SHOWING THE COURSE OF THE AERODROME IN ITS FLIGHT ON THE POTOMAC RIVER AT QUANTICO.

do here, is found to be made of innumerable currents and counter currents which exist altogether and simultaneously in the gentlest breeze, which is in reality going fifty ways at once, although, as a whole, it may come from the east or the west; and if we could see it, it would be something like seeing the rapids below Niagara, where there is an infinite variety of motion in the parts, although there is a common movement of the stream as a whole.

All this has to be provided for in our mechanical bird, which has neither intelligence nor instinct, without which, although there be all the power of the engines requisite, all the rigidity of wing, all the requisite initial velocity, it still can not fly. This is what is meant by balancing, or the disposal of the parts, so that the air ship will have a position of equilibrium into which it tends to fall when it is disturbed, and which will enable it to move of its own volition, as it were, in a horizontal course.

Now the reader may be prepared to look at the apparatus which finally has flown. In the completed form we see two pairs of wings, each slightly curved, each attached to a long steel rod which supports them both, and from which depends the body of the machine, in which are the boilers, the engines, the machinery, and the propeller wheels, these latter being not in the position of those of an ocean steamer, but more nearly amidships. They are made sometimes of wood, sometimes of steel and canvas, and are between 3 and 4 feet in diameter.

The hull itself is formed of steel tubing. The front portion is closed by a sheathing of metal which hides from view the fire grate and apparatus for heating, but allows us to see a little of the coils of the boiler and all of the relatively large smokestack in which it ends. The conical vessel in front is an empty float, whose use is to keep the whole from sinking if it should fall in the water.

This boiler supplies steam for an engine of between 1 and 1½ horse power, and, with its fire grate, weighs a little over 5 pounds. This weight is exclusive of that of the engine, which weighs, with all its moving parts, but 26 ounces. Its duty is to drive the propeller wheels, which it does at rates varying from 800 to 1,200, or even more, turns a minute, the highest number being reached when the whole is speeding freely ahead.

The rudder, it will be noticed, is of a shape very unlike that of a ship, for it is adapted both for vertical and horizontal steering. It is impossible within the limits of such an article as this, however, to give an intelligible account of the manner in which it performs its automatic function. Sufficient it is to say that it does perform it.

The width of the wings from tip to tip is between 12 and 13 feet, and the length of the whole about 16 feet. The weight is nearly thirty pounds, of which about one-fourth is contained in the machinery. The engine and boilers are constructed with an almost single eye to economy of weight, not of force, and are very wasteful of steam, of which they spend their own weight in five minutes. This steam might all be recondensed and the water re-used by proper condensing apparatus, but this can not be easily introduced in so small a scale of construction. With it the time of flight might be hours instead of minutes, but without it the flight (of the present aërodrome) is limited to about five minutes, though in that time, as will be seen presently, it can go some miles; but owing to the danger of its leaving the surface of the water for that of the land, and wrecking itself on shore, the time of flight is limited designedly to less than two minutes.

I have spared the reader an account of numberless delays, from continuous accidents and from failures in attempted flights, which prevented a single entirely satisfactory one during nearly three years after a machine with power to fly had been attained. It is true that the aërodrome maintained itself in the air at many times, but some disaster had so often intervened to prevent a complete flight that the most persistent hope must at some time have yielded. On the 6th of May, of last year I had journeyed, perhaps for the twentieth time, to the distant river station and recommenced the weary routine of another launch, with very moderate expectation indeed; and when on that, to me, memorable afternoon the signal was given and the aërodrome sprang into the air * I watched it from the shore with hardly a hope that the long series of accidents had come to a close. And yet it had, and for the first time the aërodrome swept continuously through the air like a living thing, and as second after second passed on the face of the stop watch until a minute had gone by and it still flew on, and as I heard the cheering of the few spectators, I felt that something had been accomplished at last, for never in any part of the world or in any period had any machine of man's construction sustained itself in the air before for even half of this brief time. Still the aërodrome went on in a rising course until, at the end of a minute and a half (for which time only it was provided with fuel and water), it had accomplished a little over half a mile, and now it settled rather than fell into the river with a gentle descent. It was immediately taken out and flown again with equal success, nor was there anything to indicate that it might not have flown indefinitely except for the limit put upon it.

I was accompanied by my friend, Mr. Alexander Graham Bell, who not only witnessed the flight, but took the instantaneous photograph of it which has been given. He spoke of it in a communication to the Institute of France and in a similar communication to Nature.

On November 28 I obtained, with another aërodrome of somewhat similar construction, a rather longer flight, in which it traversed about three-quarters of a mile, and descended with equal safety. In this the speed was greater, or about 30 miles an hour. The course of this date is indicated by the dotted line in the diagram. We may live to see airships a common sight, but habit has not dulled the edge of wonder, and I wish that the reader could have witnessed the actual spectacle. "It looked like a miracle," said one who saw it, and the photograph, though taken from the original, conveys but imperfectly the impression given by the flight itself.

And now, it may be asked, what has been done? This has been done: A "flying machine," so long a type for ridicule, has really flown; it has demonstrated its practicability in the only satisfactory way—by actually flying—and by doing this again and again under conditions which leave no doubt.

There is no room here to enter on the consideration of the construction of larger machines, or to offer the reasons for believing that they may be built to remain for days in the air, or to travel at speeds higher than any with which we are familiar. Neither is there room to enter on a consideration of their commercial value, or of those applications which will probably first come in the arts of war rather than those of peace; but we may at least see that these may be such as to change the whole conditions of warfare, when each of two opposing hosts will have its every movement known to the other, when no lines of fortification will keep out the foe, and when the difficulties of defending a country against an attacking enemy in the air will be such that we may hope that this will

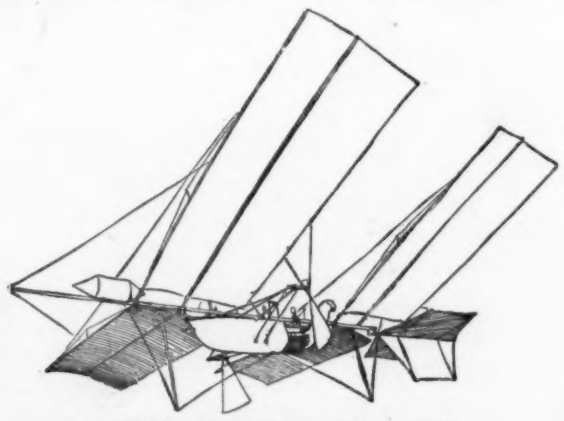


DIAGRAM OF THE AERODROME.

* The illustration from an instantaneous photograph by Mr. Bell shows the machine after Mr. Reed, who was in charge [illegible] whom a great deal of the construction of the aerodrome is due, has released it, and when it is in the first instant of its aerial journey.

hasten rather than retard the coming of the day when war shall cease.

I have thus far had only a purely scientific interest in the results of these labors. Perhaps if it could have been foreseen at the outset how much labor there was to be, how much of life would be given to it, and how much care, I might have hesitated to enter upon it at all. And now reward must be looked for, if reward there be, in the knowledge that I have done the best I could in a difficult task, with results which it may be hoped will be useful to others. I have brought to a close the portion of the work which seemed to be specially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The world, indeed, will be supine if it do not realize that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened.

IMPROVEMENTS IN THE METHODS OF QUARRYING SLATE.

A COMPLETE transformation has been made by the Société des Ardoisières of Anjou in the methods employed in quarrying slate, which industry has always been a more dangerous one than that of coal mining notwithstanding that, in the latter, it is necessary to cope with fire-damp.

The methods heretofore employed in working the slate deposits are as follows: The strata of fissile rock capable of being split into roofing slates are almost vertical, and it is vertically also that the work of quarrying them is pursued. There are two methods of extracting the slate rock. The first of these is the open air method, in which, after the removal of the top-bed of decomposed schist, the rock, cut into easily handled blocks, is raised to the surface. In the second method, a shaft is sunk, in order to reach a slate rock of good quality, and then a chamber is excavated from which the blocks are raised to the surface in order to be split into laminæ. Above the chamber there is left a certain thickness of slate schist, which possesses great solidity, and the layers of which form, as it were, long girders constituting part of the side walls at their extremities. Under this vault, the excavation constantly descends, while the blocks of rock are raised in a bucket which slides over an oblique cable stretched above the heads of the workmen. But since the roof of the vault, however carefully it may have been chiseled out at first, becomes weak in the long run, and since it is impossible to easily inspect it after the chamber has reached a great depth, blocks of stone are apt to fall upon the heads of the quarrymen with fatal results. And, moreover, if inspection of the vault roof reveals displacements and fissures therein, the only thing to be done is to desert the chamber, which will thus become unworkable because of these cracks and threatened cave-ins. Such cave-ins have many chances of extending to the surface and of involving the ruin of the entire work as well as that of the hoisting machines installed above on the surface. It should be stated, also, that the lighting of these vast chambers is accomplished with great inconvenience, and that the largest kerosene lamps hitherto employed have scarcely any other effect than to vitiate the air with smoke.

In the method of quarrying recently introduced, which is destined to completely revolutionize the industry, the work is performed in chambers, as before, but from the bottom upward. In the former method, it is the floor from which the slate is taken, while here it is the roof of the chamber that is worked. Successive layers of slate are cut from this by the workmen, who stand upon a platform suspended from the part of the roof that has been cut away. The slate, as fast as it is quarried, is removed through horizontal galleries to the main vertical shaft, where it is immediately hoisted to the surface. The height of the chamber is kept always the same by building up the floor with waste material as fast as the roof is chiseled away. Thus the waste material replaces the strata of rock as fast as they are removed from the ceiling, and the side walls can have no tendency to fall in, on account of their extremely reduced height, and that which is not so. Then, in the worthless rock, there is opened a direction gallery—a collector parallel to the vein—and from it are branched other short galleries that reach the fissile rock. Each of these turns to the right or left without joining the contiguous one, since walls are reserved between the various chambers, which these cross-galleries are to connect with. When the edge of the vein is reached,

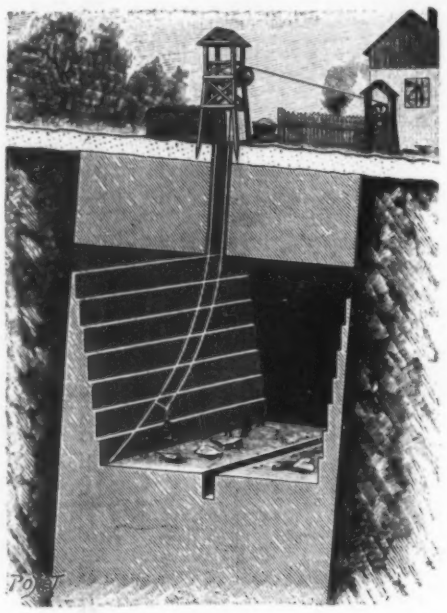


FIG. 1.—SECTION OF A WORKING CHAMBER IN THE DESCENDING METHOD OF QUARRYING SLATE.

a chamber is opened at each working point and pushed toward the other side of the vein. Its width is at right angles with the cross-gallery that connects with the main gallery, and its length is a prolongation of it. In this way there is established a working chamber which has the form of a plane-sided excavation of from 6½ to 13 feet in height, according to the more or less resistant nature of the schist. The excavating is naturally done in horizontal lines, and this of itself affords the blocks that are raised to the surface after passing through the galleries already mentioned. It is sometimes necessary to raise the waste material to the surface, whence it may afterward be let down again for filling in; but the order observed in the work generally permits of its being emptied immediately into the chambers, the excavation of which is sufficiently advanced to allow the lower part to be filled in, in order that a stratum above may be taken out. The work is carried on therefore, as may be understood from what we have said above, by cutting out the slate and afterward completely filling in the chamber thus made. In order to detach a 13-foot block from the ceiling, workmen standing upon a footbridge hung from the roof of the chamber, cut in the entire length of the latter a cavity 6 feet in width by 13 in height. This cavity is generally formed outside of the vein, and at its edge, starting from the working points, so as not to pulverize the slate schist uselessly. It is then possible to drill blast-holes, which are charged with powder. A block of schist the entire width of the chamber is blasted out and falls upon the floor provided by the first work. The blocks, which are sometimes resplit, are moved to the main vertical shaft and drawn up to the surface. After the first stratum has been removed, work is begun on the second, and, after it is slightly advanced,

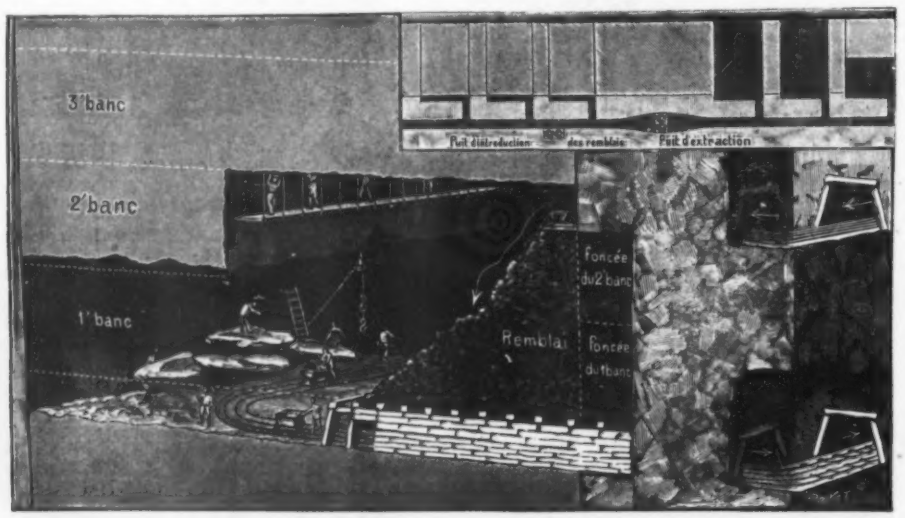


FIG. 2.—SECTION OF A SLATE DEPOSIT WORKED BY THE ASCENDING METHOD. HORIZONTAL CROSS-SECTION OF THE MINE IN UPPER CORNER.

which is by this method of working kept always about the same.

A beginning is made, then, by sinking a shaft to a depth of from 500 to 1,000 feet, outside of, but in close proximity to the wall of the vein that forms the plane of contact of the fissile or utilizable rock there is excavated, outside of the vein, a new gallery which will end at the new ceiling, at a height of 26 feet above the floor, and which is connected with the main shaft by a collector parallel to the vein. In this way, by means of this new system of galleries, it is possible to remove the blocks that fall from the second stratum and raise them to the surface at the same time the waste material is being introduced into the bottom of the chamber in order to raise the floor by the thickness of one stratum. It is hardly necessary to say that the waste material is introduced and distributed through the upper galleries, while the fissile schist that falls from the ceiling is shoveled into cars and carried through the lower galleries, the prolongation of which under the accumulating spoil is protected by timbering. Things continue thus until, in ascending, the non-utilizable stratum of schist is reached. Moreover, when it is desired to work a vein of great thickness, it is preferred to divide the field of operation into two symmetrical parts, by sinking the shaft toward the center of the vein, tracing the collector through the axis of the latter, and opening the chambers on each side of the collector.

If we add that the electric light has been adopted in the majority of the slate mines of the Angers region, and that, in addition, the Société des Ardoisières of Anjou, the inventor of this method of mining, has constructed and is regularly employing, for moving the blocks in the chambers, and loading them upon the cars, very well arranged electric windlasses which a boy can operate and which have all the power desirable, while affording absolute security against accidental descents of the load, it will be seen that we do not exaggerate when we say that a genuine revolution is in the way of taking place in the method of quarrying slate.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

AMBER, THE GOLD OF THE NORTH.*

AMBER was highly regarded, even in remote antiquity. Long before the days of Homer, the Phœnician amber dealers were wont to tell how, in the northwestern part of Hesoid's map of the earth, where a river rising in the Alps, poured into the ocean, the heat of the sun caused certain trees to exude the gum electron (the name under which the amber was known to the Greeks). Homer makes mention of amber in the Odyssey. The clearness of the declarations of the ancients in regard to the true nature of amber caused much confusion of ideas in recent times on the origin of the substance. Even Linnæus went to considerable trouble to defend the opinion of its vegetable origin. Indeed, it was not till near the end of the nineteenth century that the natural and geological relations of the substance were recognized, and it was known to be the fossil resin of a pine. Numerous well preserved enclosures found in the gum have enabled naturalists to form a very nearly correct idea of an amber tree forest, which consisted mainly of a thuya, agreeing very closely with still extant varieties.

The collection of amber until very recently has been by very archaic and primitive methods. The attention of the government was, however, called to it a few years ago, and since then modern and progressive methods have been adopted. From an article on the subject which appeared recently in the Woche, we gather the following interesting facts:

The resin of a fossil conifer to which we have given the name of amber, collected during the course of ages in the "blue earth"—a stratum occurring in the sands of the Baltic about at the level of the sea. This "gold of the North," the electron of the ancients, a hard, translucent and sometimes transparent substance, of a yellow color generally, and capable of a high polish, was so highly prized by the ancients, that it was the object of voyages of discovery to the northern shores.

In the second half of the thirteenth century, with the capture of the seat of the main deposits of amber—the East-Prussian peninsula of Samland—by the Knights of the Teutonic Order, we first begin to find reliable historical information regarding the mining and working and the trade in the substance. In 1533, Paul Jaski, the first wholesale dealer in amber, closed a contract with Duke Albrecht, which gave him the right of refusal, as first purchaser, of all amber mined in the domain, and we can say that with the extinguishment of the Jaski family began the decline of the amber industry. From the year 1811, when this occurred, the Königsberger amber turning interests slowly began to retrogress. The "blue earth" stratum, in which the greatest deposits of amber exist, is worked now at Schwarzort (literally "black place"). The principal seat of the amber mining industry, indeed, the only place where this fossil resin is found in any considerable quantity, is still the west coast of Samland, from Brüsterort to Palmecken.

The sporadic search for amber, which, by making extensive excavations in the coast hills led to the sanding up of much arable property, was put an end to by the government (Prussian), which, in 1867, forbade, once for all, these irregular, aimless and planless methods. Valuable results can be produced only by systematic methods, like those of the late Privy Councilor (Geheimrath) Moritz Becker, at Palmecken, instituted in 1875.

Becker, with this in view, united forces with the wealthy East-Prussian ship-owner, Stantien, and founded that flourishing industry, the Samland mine. To-day the mine is owned by the Prussian government, and is in the direct control of the ministry of agriculture, public land and domain. The annual rental agreed upon in the last contract, is a minimum of 300,000 marks. The highest sum taken in any one year by the state since its monopoly of the industry in 1770, was that returned in 1877, which amounted to 770,000 marks. This sum, which, by the way, has not since been duplicated, was brought about by the adoption of a new mining method, namely, the search for amber under the water by the use of divers and diving apparatus.

The divers, supplied with air by means of pumps, work two in each boat. On reaching bottom (about 12 feet deep on an average) they ply the spade and the pick alternately. The greatest finds have been in the deeper water, thus far. Indeed, the deeper the water, the more plentiful the amber, is a proverb. In Palmecken alone, more than 1,000 men are employed in this manner.

The sorting of the amber is done at the Königs-

* A translation from the Droguen und Farbwaaren Haendler, published in the National Druggist.

berger government amber works. There are 30 different kinds known to the trade. Certain kinds go only to South Africa; certain others to South America; others for Central Africa, etc. Some kinds are entirely for Mohammedans. Such, for instance, are the knobs or large pieces used on stems of the narghilehs or water-pipes of the Turks. The headquarters for the varieties used in the Orient are Vienna, where there are over 50 workshops, employing a large number of highly skilled artists. In Paris, London, Constantinople, New York, City of Mexico, Calcutta, Hong-Kong, and Yeddo, amber has become a valuable item in commerce.

THE WASHINGTON INCANDESCENT PETROLEUM GAS LIGHT.

FEW visitors entering the Düsseldorf Exposition through the Court Garden Gate will have passed the kiosk at the left-hand side without noticing, if only for a moment, the dazzlingly bright light in the same. As announced by an inscription on the dainty little temple, it is the Washington light, named after its inventor, George Washington. It is an incandescent petroleum light without wick, the petroleum being supplied to the burner (which carries a mantle of the size of the Welsbach mantle), through a one millimeter brass tube, and under a pressure of three to four atmospheres. Upon entering the burner the petroleum is gasified, so that only petroleum gas rises into the mantle, under the air pressure, which is six times that used in the case of illuminating gas. In consideration of this increased pressure, the mantle has been made correspondingly firmer than the one employed by Auer for illuminating gas flames. A mantle develops an illuminating power of about 250 Hefner candles, hence about four to five times that of a good gas mantle. Lamps with two and three mantles are also made, the two-flamed lamp, which possesses an illuminating power of 500 Hefner candles, being capable of serving as a substitute for an electric arc light.

The petroleum is kept in a steel plate receptacle provided with an air pump and a manometer from which it is conveyed to the lamp by a pipe conduit. Any number of lamps may be connected by means of branch conduits to the main line. Owing to this arrangement the Washington light is especially adapted for large halls, assembly rooms, railway stations, large shops, etc., but is also commendable for adjoining offices, workshops, etc. By reason of its great illuminating power it seems especially fitted for street lighting. The lamp inside a globe such as is used for arc lights is, like the latter, mounted on a post in the lower part of which the petroleum tank is located, the pressure being supplied by a portable pneumatic pump.

The lamps and installations are furnished by the Washington Light Company, Ltd., of Elberfeld, Germany. As regards the cost of lighting, this lamp, according to the statements of the company, far exceeds all other modes of illumination in cheapness. It is claimed that a Washington light of 500 Hefner candles illuminating power costs but 4 pfennige (1 cent) per hour to run, while an arc light costs 23 pfennige (5¾ cents). This estimate is based on petroleum at 22 pfennige (5½ cents) per kilogramme (2.2 pounds), and electricity at 60 pfennige (15 cents) per kilowatt hour.

An incandescent gas light of 50 Hefner candle-power is put down at 16 pfennige (4 cents) per hour. The writer would like to state that no odor of petroleum was noticeable in the Exposition Building.

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Prometheus.

THE PEANUT.

HERE in Virginia we designate our little friend principally as the peanut, but quite often we likewise allude to him as a "ground-pea," and occasionally as a "goober." Over in England they call the same fruit "groundnut," while it is variously known elsewhere as "earthnut," "Manila nut," "jur-nut," and "pindar." The scientific patronymic, as we understand it, is *Arachis hypogæa*, and the family belongs to the genus of leguminous plants.

Down in South Carolina just now they are cracking lots of jokes about peanuts—or rather, "pindars"—for they call them by that name in the Palmetto State. A Columbia contemporary pokes fun at the South Carolina legislators who exhibit a peculiar and most abnormal fondness for pindars during business hours.

Our own Solons show the same weakness, and we cannot recall a session of the Legislature when groundpeas were not on sale at the Capitol. Not so very long ago the member from Lee County was himself the proprietor of a peanut stand, and brought his son down to Richmond to conduct the enterprise. This stand was in the rotunda of the Capitol, and there was not an hour during the day when the marble Washington failed to behold statesmen eating peanuts.

The famous old stove brought hither from the Capitol at Williamsburg when Richmond became the seat of the State government seems to have been designed to give as much surface space as possible for the roasting of peanuts. At any rate, the stove was used in part for that purpose, and so continued to serve legislators as long as a fire was lighted in it.

A persistent effort long has been made to stamp the peanut with the mark of vulgarity, but this nefarious scheme has been a total failure. Never was the peanut so popular as it is to-day. It is crowding its haughty kinsman, the salted almond, off the festal board, and it is rapidly receiving wide recognition as a delicacy. Time was when goobers were synonyms of circus rowdyism, gallery gods' obstreperousness, and festive occasions of the proletariat. Now the peanut—especially the Virginia product—travels on its merits, and comes in contact with the best people of our land.—The Richmond Dispatch.

THE PRESERVATION OF FRUIT JUICES.

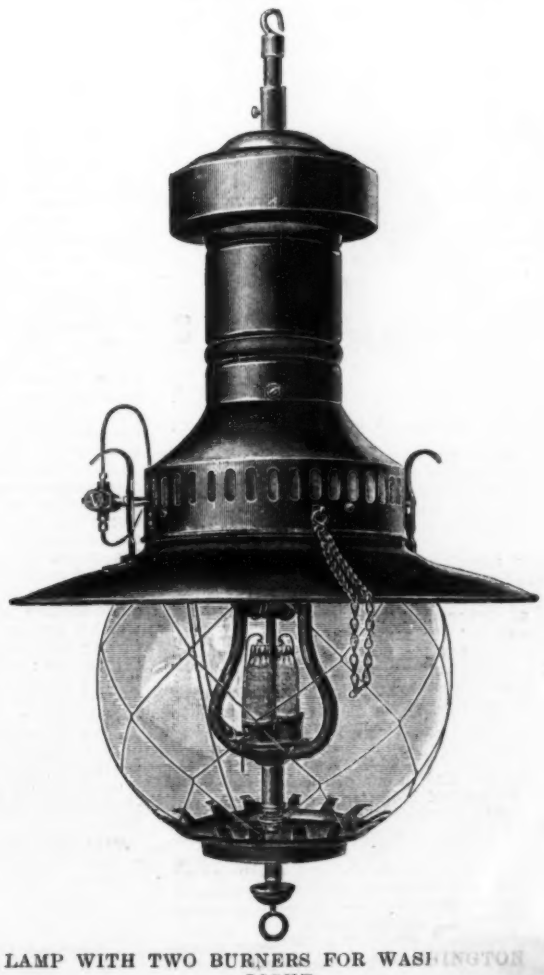
DURING the fruit season of last year, we alluded to the possibility of the preservation of fruit by the use of saccharin, without the old and tedious process of heating the bottles containing the fruit for a period of from two to three hours. From some experiments then carried out, though only on a very small scale, it was found as the result of careful observation that this heating process may be dispensed with, at least for a time, though for eventually sending out, even with saccharin as a sweetening agent, it may be the safest and more satisfactory method. There can be no doubt, however, that sound (i. e., neither damaged, decayed, nor bruised), ripe fruit may be kept in suitable quantities for a considerable time, if covered with a solution of saccharin and left undisturbed, this, too, without deteriorating the taste, color or aroma of the fruit if packed with care. The advantages of a temporary, easy and ready preservative are obvious, for it enables the manufacturer to stock a quantity of fruit which he may retain till he may have either more time to attend to it, or a better chance of deciding for what purpose he may employ it, and these are matters of no mean importance. Whole fruit may thus be stored in bulk, by carefully and without fracture filling into convenient sized jars or bottles, and pouring thereon a solution containing a quarter of an ounce of refined saccharin to the gallon of water, so filling each vessel that the solution is within an inch of the cork when pressed into position. The corks should first of all be immersed in melted paraffin wax, then drained and allowed to cool.

When fruit juices alone are required for storage purposes they are prepared by subjecting the juicy fruits to considerable pressure, by which process the juices are liberated.

The sound ripe fruits are crushed and packed into felt or flannel bags. The fruit should be carefully selected, rotten or impaired portions being carefully removed; this is important, or the whole stock would be spoiled. Several methods are adopted for preserving and clarifying fruit juices. A common way in which they are kept from fermenting is by the use of salicylic acid or other antiseptic substance, which destroys the fermentative germ, or otherwise retards its action for a considerable time. About two ounces of salicylic acid, previously dissolved in alcohol, to twenty-five gallons of juice, or forty grains to the gallon, is generally considered the proper proportion.

Another method adopted, and which is quite practicable, is to fill the freshly prepared cold juice into bottles until it reaches the necks, and on the top of this fruit juice a little glycerine is placed. Juices thus preserved will keep in an unchanged condition in any season. Probably one of the best methods of preserving fruit juices is to add 15 per cent of alcohol 95 per cent. On such an addition, albumen and mucilaginous matter will be deposited. The juices may then be stored in large bottles, jars or barrels, if securely closed, and when

POST WITH TANK IN THE BASE FOR WASHINGTON LIGHT.



LAMP WITH TWO BURNERS FOR WASHINGTON LIGHT.

allowed to remain undisturbed they become perfectly clear, so that further clarification is unnecessary; the juice should then be decanted or siphoned off. An efficient way of clarifying fruit juices is to heat them with a small quantity of albumen (white of egg) in an enameled vessel, provided with a close-fitting lid, without stirring, to near the boiling point of water. The impurities under this treatment coagulate, and either rise to the top or fall to the bottom; they then need to be filtered through felt or flannel. This heating process most effectively destroys the germs of fermentation, and the subsequent filtration clarifies the juices, which should be kept in a cool place; so stored they will remain unchanged for an indefinite period if they have been properly and carefully prepared. Corks should be coated with wax, and if possible the bottle necks dipped. Great care should be observed in heating the juices, no more being applied than absolutely necessary, or the delicate aroma will suffer.—Min. Water Trade Review.

THE CONVERSION OF AMORPHOUS CARBON TO GRAPHITE.*

By FRANCIS J. FITZGERALD.

THE commercial production of graphite from amorphous carbon having been brought to a successful issue by the Acheson process, the object of the following article is to set forth certain results which have been obtained by various experimenters and have a bearing on the subject. No attempt will be made to review all the work that has been done, but rather to collect in one place some of the more important experiments and speculations which are connected with the relations of amorphous and graphitic carbon.

The earliest systematic experiments on the effect of the high temperature obtainable by electrical means on carbon were those of M. Despretz.† In his experiments, Despretz used a battery of 600 Bunsen cells, which could be connected up in various ways, according to the nature of the work required, and with these he tried the effect of high temperatures on different varieties of carbon: Retort carbon, anthracite coal, graphite, sugar carbon, carbon obtained by decomposing turpentine in a strongly heated porcelain tube, and finally on diamond. He states, that so far as he could discover, all previous experimenters had come to the conclusion that "carbon is fixed and infusible." Referring to an earier communication (July 9, 1894), he says: "I proved (there) that carbon is volatile like all the bodies called refractory. . . . This volatilization appears in the form of a black cloud which arises from the whole surface of the carbon and deposits, in great part, on the walls of the vessel in which the carbon connecting the two poles of the battery is placed. . . . As I found that carbon dissipated rapidly, both by volatilization and combustion, I tried to diminish the volatilization and eliminate the effect of combustion by working in nitrogen or in a gas that would not support combustion, at a pressure greater than that of the atmosphere."‡

The apparatus used by Despretz for these experiments consisted of a cast-iron box, having a capacity of about 10 liters, and provided with a movable cover so that capsules could be placed above and below the material treated with the current or the arc. A vertical rod passed through a leather stuffing box in the cover, and a similar rod passed horizontally through one of the walls of the box. A holder of carbon was attached to each rod. The interior of the apparatus could be observed during the operation through two holes closed with thick glass. Two tubes were also provided, one of which was connected to a manometer, while the other made communication either with an exhaust or compression pump. By means of this apparatus, a current could be passed through a piece of carbon, connecting the carbon holders attached to the vertical and horizontal rods, while in a vacuum or in a gas. In order to experiment with an arc, Despretz had another cover provided with two rods, at the end of which were attached the carbon holders and between which an arc could be drawn, while with the third rod a piece of carbon could be introduced into the arc. Despretz describes various experiments in which he placed carbon rods between the two electrodes, and causing a current to pass through them bent the rods, and makes his first mention of graphite in the following experiment. The carbon rod, 2 centimeters long and 2 millimeters in diameter, was placed between the electrodes, and the current from the 600 cells, arranged in twelve series of fifty elements, was passed through it with the result that the rod bent and broke, the upper part showing an enlargement at the fracture. This enlarged portion resembled "slag" and the ends of the carbon were graphite. In a note on this point Despretz says:

"These experiments are always complex. I describe experiments in which the carbon is bent; but as this result can only be obtained at the highest temperatures, it happens at the same time that in nearly every case a part of the carbon fused and changed into graphite."§

Several other experiments are described in which carbon rods are heated in a similar manner and afterward found to be graphite. In one of them an electrode, formed of carbon, had "swelled up and was converted into graphite." In some other experiments in which sugar-carbon powder was used for making a close contact with the holders, "certain globules in the powder had been formed by the heat; and in some cases the transformation of the powder into graphite was complete." These phenomena are taken as evidence of fusion.

Despretz next describes how a carbon filament is introduced into the arc, and in one of these experiments with a kind of carbon not indicated the end of the rod swelled up and was converted into graphite. In another experiment a piece of carbon made from turpentine was introduced into the arc with the result that it "shows some points on the heated end which appear to be fused. This end has acquired the properties of graphite, making marks like that substance, but it does not at once become so brilliant on rubbing, nor is it as soft to the touch."

Experiments are next described in which an arc is made to play on pieces of carbon placed in a sugar-carbon crucible which forms the positive electrode. The most interesting of these experiments, in view of the modern manufacture of graphite, are described as follows:

"Some nearly pure anthracite, treated in the same way, spread out on a crucible like a black glass. . . . A much larger piece of this substance (anthracite) treated in the same manner by the battery, which had been weakened by numerous experiments, exfoliated. The part which received the direct action of the heat became bluish gray in color and was clearly graphite. The part on the edges of the crucible became less hard but was not yet graphite."*

The last experiments we shall notice are described as follows:

"I covered and impregnated some acicular rods of carbon with more fusible materials, silica, alumina and magnesia, in order to see if the presence of more fusible substances made the fusion of the carbon easier in the heat from the battery. The silica, alumina and magnesia were dissipated in the form of vapors and the carbon remained behind retaining its (original) properties.

"I placed an acicular rod of carbon in a clay crucible, filled the latter with well-dried sand, and then passed a current through the carbon which fused and volatilized. I found a sort of very hard fulmineous tube, of which the inside was lined with smoked quartz. The inside diameter was at least ten times that of the carbon." †

As the result of his experiments Despretz concludes that:

"In a vacuum, carbon manifestly vaporizes at the temperature to which it is raised by a battery of 500 to 600 Bunsen cells connected in five or six series. In a gas the vaporization is more gradual but likewise occurs.

"Carbon brought to the temperature which we obtained in our experiments may be bent, welded and fused.

"Any carbon which is submitted for a long time to a high temperature becomes proportionately softer. Finally it is transformed into graphite."‡

In 1870, M. Berthelot published a very interesting article on the allotropic forms of carbon. He refers to the loose way in which the term graphite is employed, as follows:

"Many varieties of amorphous carbon, such as natural plumbago and various artificial carbons, have been associated with graphite. Thus, Berzelius identifies with metallic carbons, coke obtained from the calcination of oil, also charcoal and lampblack after they have been exposed for some time to an intense red heat. In the same way Despretz applies the name graphite to retort and sugar-carbons after they have been heated some time either by the enameling lamp or the electric arc. M. Regnault and M. Caron have designated certain gas-retort carbons with the same name and otherwise conform to Berzelius' opinion.

"If I cite these authorities to specify the sense which has been attached in general, up to the present, to the word graphite, it is because the definition of this substance, whenever it is not crystalline, lacks strictness and gives rise to many ambiguities. For example, the property of marking paper which has often been cited as characteristic of graphite does not belong either to metallic carbons or to certain carbons which I shall class with true graphites; while it is present in lampblack and some other amorphous carbons."§

M. Berthelot then goes on to describe Brodie's discovery of the production of graphitic oxide by the oxidation of graphite with nitric acid and potassium chlorate. As a result of his study of Brodie's process, Berthelot describes a method of distinguishing the various forms of carbon:

"This method consists in oxidizing the carbon at a low temperature and examining the products formed, under these conditions:

"(1) Diamond is not appreciably oxidized, even by long and repeated treatments, and this is the case whether ordinary or black diamonds are concerned.

"(2) The different varieties of amorphous carbon are completely changed into humic-like acids, yellowish brown in color and soluble in water; the properties of these acids vary, following the carbons which yield them.

"(3) The different varieties of true graphite are changed into corresponding graphitic oxides; the properties of these oxides vary notably with the nature of the graphite from which they are produced; but all are characterized in one way by their insolubility, and above all by their property of decomposing rapidly and with deflagration, when heated." ‖

Berthelot then describes the method he employs for treating the carbon under examination with the oxidizing mixture; calls attention to the fact that the various products of oxidation would lead to a separation of the graphite and amorphous classes into numerous distinct groups and goes on to say:

"Whatever these more subtle distinctions which require further research may be, the method of analysis which I propose permits a very clear recognition of the three principal groups which comprise the varieties of carbon, viz.: diamond, amorphous carbons and graphites. I propose hereafter to reserve the name graphite exclusively for those carbons which yield a graphitic oxide; this definition will be found to be sufficiently precise and will not give rise to the old ambiguities."¶

After describing the method of applying his tests, Berthelot takes up its application to graphites:

"There exist many distinct varieties of graphites: I shall notice especially three, which I have successfully distinguished:

"(1) The graphite of natural plumbago.

"(2) The graphite of cast iron.

"(3) Electrical graphite, obtained by the transformation of different varieties of carbon under the action of the electric arc. . . .

"A. PLUMBAGO.

"(The variety observed by Mr. Brodie.)

"The graphitic oxide formed occurs, in the moist state, as micaceous plates of a pale yellow color, insoluble in all solvents (neutral, alkaline or acid) and unaltered by repeated oxidizing reactions. It contains neither chlorine nor nitrogen.

"When it is dried, even at the ordinary temperature, it agglomerates in brown, amorphous, tenacious plates in which the original structure disappears. . . .

"B. GRAPHITE FROM CAST-IRON.

"The graphitic oxide from cast-iron occurs in greenish yellow scales, better developed than those of plumbago, and which do not agglomerate in any way during desiccation, but still retain a very characteristic yellow or greenish yellow tint. This characteristic distinguishes them clearly from oxide of plumbago. . . .

"C. ELECTRIC GRAPHITE.

"The graphitic oxide of electric graphite has the appearance of a maroon-colored powder, and does not agglomerate sensibly."*

Next follows an interesting study of the relations between graphitic compounds and organic compounds properly so called, after which there is a discussion of "the actual states of carbon," where the oxidizing action is applied to the usual varieties of carbon, to carbon that has been treated in various ways, and, finally, to carbon prepared by the decomposition of its compounds with numerous other bodies, such as hydrogen, oxygen, metals, etc. Passing over the experiments on the "usual varieties," we come to the consideration of the effects of heat:

"By the action of heat alone, that is to say, by calcining graphites and various amorphous carbons at a white heat in an atmosphere of hydrogen, I never was successful in passing from one group to another; only amorphous carbons appeared to show some increase in cohesion. . . .

"Chlorine, at a white heat, does not change charcoal into graphite nor graphite into amorphous carbon; it is known, besides, that chlorine does not attack free carbon. Iodine at a red heat does not change coke into graphite; on the other hand, iodine brings about this transformation by acting on nascent carbon, as will be shown later.

"The action of oxygen is more complicated. It, in fact, gives rise simultaneously to an extreme elevation of temperature and to a formation of dioxide and monoxide of carbon. Carbon submitted to this double action may be studied by burning a retort-carbon rod, previously heated to redness, in a stream of oxygen. When the end of the rod is fully incandescent it is rapidly extinguished by plunging it in cold water. Then the extreme point of the pencil is removed, care being taken to confine oneself as far as possible to that portion which has been most strongly heated. The carbon thus treated is no longer composed exclusively of amorphous carbon, but contains a small quantity of graphite formed by the double action of heat and oxidation. . . .

"No action is more worthy of interest than that of electricity. I have examined, by the new method of analysis, the carbon poles used in the electric light. It is known that under this action the carbon is vaporized and passes from the positive pole, which becomes continually smaller, to the negative pole, which becomes covered with a spongy mass. I oxidized the carbon powder collected from a large number of carbons that had been used in producing electric light and obtained great quantities of graphitic oxide. This graphitic oxide, and, consequently, electric graphite, are not identical with those of cast-iron or those of plumbago. . . .

"The formation of electric graphite does not occur indifferently at the two poles. The negative poles, thickened by the transport of the carbon, alone yielded a large quantity of graphitic oxide; while the corresponding positive poles, attenuated by the action, only contained traces; moreover, these were probably due to the necessarily imperfect separation of the carbon which deposited on the poles during the action of the electric light.

"Nevertheless, the transformation into graphite does not necessitate the preliminary volatilization of the carbon. In fact, the capsules of sugar carbon, softened by the arc from a battery of 600 elements, were found to be, in great part, changed into graphite at the negative pole." †

The capsules referred to were those used by Despretz in his experiments.

Omitting details, the results of the next experiments are as follows:

Decomposition of hydrocarbons by heat alone yields amorphous carbon.

Decomposition of methane by the electric spark yields amorphous carbon with a trace of graphite.

Decomposition of methane by chlorine yields amorphous carbon.

Decomposition of benzene, naphthalene and other hydrocarbons at 280 deg., as iodine and hydrochloric acid, yields amorphous carbon; but at higher temperatures decompositions with these reagents can be effected with the production of considerable quantities of graphite which appear to be analogous to the electric variety.

Lampblack, produced by the combined action of heat and oxidation, yields traces of graphite.

Decomposition by heat of chloride of carbon yields graphite in considerable quantities, and the same results are obtained by the decomposition of carbon bisulphide, though the graphite obtained from the latter will not mark paper.

Cyanogen, decomposed by the electric spark, yields amorphous carbon with traces of graphite.

Sodium carbonate, decomposed by heating with phosphorus, yields amorphous carbon and a little graphite.

Red-hot sodium reacting with sodium carbonate yields

* Journal of the Franklin Institute.
† Comptes Rendus, T. xxix, No. 25, pp. 709-724.
‡ Ibid., p. 710.
§ Ibid., p. 714.

* Ibid., p. 719.
† Ibid., p. 720.
‡ Ibid., p. 724.
§ Annales de Chimie et de Physique, p. 302, 3 Serie, Tome xix.
‖ Ibid.
¶ Ibid.

* Ibid.
† Ibid.

a small quantity of carbon composed, in great part, of graphite. The experiments with carbide of boron and certain metallic carbides are of such interest, in view of later work, that they will be quoted in full.

"*Carbide of Boron.*—It is known that M. H. Saint-Claire Deville has designated by the name of adamantine boron a variety of crystalline boron, which is hard and brilliant and contains a certain percentage of carbon. It is easy to separate the carbon by treating the boron with a current of dry chlorine at a red heat. I have effected this separation at two very different temperatures, namely: At a temperature lower than that of the softening of glass, and at a temperature near that of the fusion of porcelain. In both cases the carbon was composed of graphite, transformable into graphitic oxide and not containing the faintest trace of diamond. The only difference between the two experiments was, that the graphite prepared at a dull red heat was amorphous, while the graphite prepared at a white heat was crystallized in the hexagonal form well known to mineralogists.

"The latter carbon was deposited, in part, at some distance from the place where the boron had been originally placed—a phenomenon of transport which is probably due to the formation of a double chloride of carbon and boron. Some of the crystals, on account of an unequal development of their angles, showed in a striking manner under the microscope the appearance of truncated octahedra, calculated to lead a prejudiced mind into error. Observed in place, that is to say, on the surfaces, where they were deposited, these crystals presented a singular luster and brightness which is never looked for in a substance like graphite. Nevertheless, the form of these crystals, when examined, as well as their transformation into graphitic oxide, leaves no room for any doubt.

"*Carbide of Iron.*—It is known that graphite separates from cast-iron in crystalline plates. I examined likewise the combined carbon in iron. It was separated from white cast-iron by two distinct processes, namely: by the action of chlorine at a dull red heat and by the action of mercuric chloride (Boussingault's process).

"The carbon obtained in this way is, in both cases, composed of a mixture of amorphous carbon (predominant) with a little graphite. It would be interesting to know if there exists some relation between the various properties of cast-irons and steels and the amorphous or graphitic nature of the carbon which is found there in the combined state.

"*Carbon from Manganese.*—M. Caron was kind enough to give me a specimen of carbon which he had separated from some metallic manganese prepared by him. This specimen was composed entirely of amorphous carbon.

"Recapitulating, the carbon separated from the carbides of hydrogen by the action of heat does not contain a trace of graphite; while the carbon separated from sulphide and chloride of carbon by the action of heat or from boron by the action of chlorine contains a considerable quantity of graphite. The carbon separated from carbon dioxide (combined with soda) cannot be obtained under conditions as simple or as free from secondary complications; with this reservation, we have seen that the carbon separated either by means of phosphorus or sodium contains a certain proportion of graphite. It is the same with the carbon separated from organic compounds by incomplete combustion, that is to say, under the combined action of heat and oxygen.

"I believe it results from these observations that carbon in separating from hydrogenous compounds, assumes by preference the state of amorphous carbon; while carbon separating from its combinations with chlorine, sulphur, boron and perhaps oxygen under the action of heat, shows a certain tendency to assume the state of graphitic carbon. I have already pointed out an analogous contrast between the several states of sulphur separated from its combinations. Finally let us add, that graphitic carbons and amorphous carbons seem to represent, not the several states of carbon itself, such as would exist in its compounds, but certain corresponding polymeric states of that element.

"All these comparisons, I repeat, are of the same order as those which result from the study of the manifold states of sulphur and phosphorus in their combinations. But there exist here certain analogies and certain dissimilarities on which it is important to insist.

"In fact, sulphur in its various states has the same specific heat, and this is also the case with ordinary and red phosphorus. The variety of these isomeric states of a given element does not surpass that which exists between the isomeric states of a given liquid hydrocarbon such as the states of the carbide $C_{20}H_{16}$—terebenthene, citrene, terebene. Neither does it surpass that which exists between the various polymers, liquid or solid, of a given carbide in different states of condensation, such as $C_{20}H_{16}$. In fact, all these carbides possess nearly the same specific heat.

"Such also are the differences which exist between the several graphites, whether the several graphites represent the manifold isomeric states of a given, equally condensed carbon, or whether they correspond to the several condensations of that element. Similar remarks apply in general to amorphous carbons. Here, then, we have examples of a certain species of isomerism and polymerism which does not change the specific heat appreciably.

"On the other hand, the comparative study of amorphous carbons, graphites and diamond reveals to us another mode of the condensation of matter more profound than that of ordinary polymerism, and communicating to the specific heat variations of the same order as those observed in passing from one elementary body to another." *

M. Moissan made a very careful research on the different varieties of carbon—amorphous, graphite and diamond—finally producing diamonds in his electric furnace.† His experiments show that "it is very difficult to obtain pure amorphous carbon."

"When carbon is obtained at ordinary temperatures and pressures, it appears in the form of an impalpable maroon-colored powder. It is very light, is not hard and is easily oxidized by nitric or chromic acid.

"This carbon always contains a certain amount of some elementary bodies—hydrogen, iodine, lead, zinc, etc.—with which it is associated during the reaction. To remove these impurities the carbon must be heated, that is to say, it must be polymerized." ‡

In his study of graphite Moissan examined a number of natural graphites, then proceeded to produce graphites in the electric furnace and describes three methods of performing that operation, which are briefly as follows:

(1) Amorphous carbon is heated to a very high temperature in the electric furnace, the conversion to graphite being effected by "simple elevation of temperature."

(2) An excess of carbon is dissolved in a metal or metalloid at a high temperature. The solvent is then allowed to cool down and the excess of carbon separates in the form of graphite.

(3) Carbon is dissolved or combined with another element and then thrown out as graphite by the introduction of some other body.

While lack of space forbids a description of all Moissan's experiments, typical examples illustrating the different methods may be noted.

(1) "Sugar carbon, purified by chlorine and placed in a closed crucible, was heated for ten minutes by an arc of 350 amperes and 70 volts. The appearance of the carbon is sensibly the same as before the experiment; however, its color has become grayer. . . . At the third treatment with the oxidizing mixture (potassium chlorate and nitric acid) it was transformed into pale yellow graphitic oxide.†

(2) "When aluminium is heated for five or six minutes in the electric furnace (350 amperes and 70 volts) in the presence of sugar carbon or simply in a carbon crucible, the metal carburizes and on cooling a residue, showing a yellow crystalline fracture and containing aluminium carbide, C_3Al_4, is obtained. If it is heated for ten or twelve minutes, the aluminium carbide volatilizes partially and there remains a brittle, porous, gray substance covered with crystals of graphite. The latter is separated by treatment with hydrochloric acid, then purified by sulphuric and hydrofluoric acids. Finally it appears in groups of very brilliant little crystals, sometimes showing some black filaments. Its density is 2.11. On the first treatment with the oxidizing mixture the graphite swells up, and on the second the smallest fragments are completely transformed into graphitic oxide." ‡

(3) "We started out with a gray cast-iron from Saint-Chamond, which contained 3.18 per cent total carbon and 0.5 per cent scoriæ. (In the analysis of iron, the mixture of the different varieties of carbon is separated by chlorine or mercuric chloride. The residue is burnt in oxygen and we give the name scoriæ to the ash which remains.)

"Ten grammes of the cast-iron were placed in a porcelain boat lined with 2.3 grammes of boron. The whole was heated strongly in a porcelain tube filled with dry hydrogen and placed in a reverberatory furnace. After the experiment a well fused residue, covered with a black layer composed entirely of graphite, was found in the boat." §

Moissan experimented with several elements in the production of graphite by the method of different solubilities at high and low temperatures, and the experiment with silicon is of especial interest, in view of the history of the Acheson method of producing graphite.

"When fused silicon is heated in a blast furnace it dissolves carbon, which it finally gives up in the form of graphite—clear crystalline plates of a brilliant black color and yielding a yellow graphitic oxide.

"At the temperature of the electric furnace silicon no longer yields graphite; it produces crystalline carbide of silicon." ‖

Moissan's "Study of Carbon Vapor" is also worthy of note in this connection.

"Hitherto the formation of the vapor of carbon has not been demonstrated except in the electric arc, either by spectral analysis or by M. Berthelot's beautiful synthesis of acetylene.

"The existence of this vaporization outside the arc may be demonstrated in the following fashion: If a carbon tube, having an interior diameter of about 2 centimeters, is placed in an electric furnace made of lime, and heated by a powerful arc of 2,000 amperes and 80 volts, the interior of the tube is seen to be rapidly filled with a very light, black lining produced by the condensation of the carbon vapor.

"The carbon vapor may be made visible by placing a boat containing crystalline silicon in the middle of the strongly heated carbon tube. The silicon is then seen to fuse, to enter into ebullition, and as its vapor rises it meets the carbon vapor which descends from the upper part of the tube under the heat of the arc. There is produced between the boat and the tube a network of fine needles of silicon carbide. This crystalline and transparent compound is formed by the direct union of the two vapors." ¶

(To be continued.)

* Ibid.

† Le Four Electrique, Paris, 1897, pages 53-303.

* Ibid., p. 69.
† Ibid., p. 86.
‡ Ibid., p. 88.
§ Ibid., p. 93.
‖ Ibid., p. 92.
¶ Ibid., p. 159.

CHINESE VEGETABLE WAX.**

THE customs returns of trade for the various Chinese ports give an interesting insight into the character of the articles which constitute the commerce of this country. Leaving aside tea, opium, cotton goods, etc.—familiar articles in trade reports abroad—which form the vast bulk of imports and exports, many of the minor items strike the attention of a foreign reader as being curious objects of commercial enterprise.

In the report of exports of native goods from Ichang for 1889 occur such items as 13,000 pounds of tiger's bones, valued at nearly $3,000, a price which precludes the idea that they are to be used as a fertilizer—the only use to which any one but a Chinese would think of putting them. As a matter of fact, they are to be used as medicine, a sort of tonic, which imparts to the invalid some of the tiger's strength. Another item is 9,000 pounds of "old deer's horns," worth $1,700. This is another medicinal article with whose peculiar properties the pharmacopœia of the West remains as yet unacquainted.

Perhaps the most interesting article of all, however, is "insect wax," of which 1,539,287 pounds were shipped from Ichang in 1889 in foreign ships. This immense quantity cost over 400,000 taels, or about $460,000 in gold. This "insect wax," or "white wax," the *pai-la* or *Ch'ung pai-la*, as it is called in Chinese, is a product of the western part of the province of Se-Chuen, and of parts of the adjoining province of Kooei-Choo. It is, however, in the Chien-ch'an Valley, on the An-ning River, in western Se-Chuen, that the wax insect most flourishes and finds its food most abundant. The whole subject of white wax was, by the direction of the English Foreign Office, thoroughly investigated by Mr. Hosie, Her Britannic Majesty's consular agent at Shun-King, in Se-Chuen, and from his report thereon the following account is taken:

It seems that in western China, not far from the Thibetan frontier, flourishes a tree called by the Chinese "evergreen tree," or "crackling-flea tree," from the popping of its branches when burned. It is, in fact, an evergreen with "leaves springing in pairs from the branches; they are thick, dark green, glossy, ovate, and pointed. In the end of May, and beginning of June, the tree bears clusters of small, white flowers, which are succeeded by fruit of a dark purple color." It has been classified by the authorities of the Kew Garden as *Ligustrum lucidum*. Early in the spring there appear on the bark of the boughs and twigs of this tree numerous brown, pea-shaped scales. Upon opening these they are found to contain a mass of small animals, like flour, whose movements are almost imperceptible. These are the larvæ deposited by the white-wax insect, whose scientific name is *coccus pe-la*. These shells, or scales, are gathered by the Chinese about the end of April, and carried to the prefecture of Chiating, the center of the industry, about 200 miles from the Chien-ch'ang Valley. For this journey they are wrapped in packages each containing about sixteen ounces. The utmost care is taken to protect them from the heat, as the time of the development of the larvæ into insects is near at hand, and when this occurs they make their escape.

In the vicinity of the city of Chia-ting is a plain, described by Mr. Hosie as an immense rice field.

Almost every plat of ground on this plain, as well as the bases of the mountains, is thickly edged with stumps varying from three or four to twelve feet in height, with numerous sprouts rising from their gnarled heads. These stumps resemble, at a distance, our own pollard willows. The leaves spring in pairs from the branches; they are light green, ovate, pointed, serrated, and deciduous.

The identity of this tree is uncertain, but it is supposed to be a species of ash, the *Fraxinus chinensis*. It is called by the Chinese *pai-la shu*, or white-wax tree.

The white-wax scales, upon arrival, are made up into small packages wrapped in leaves, about twenty or thirty scales in each package, and suspended under the branches of the tree. Holes are punched in the leaves which constitute their covering, and the insects, on emerging from their scales, creep up the branches to the leaves of the tree, among which they remain thirteen days. They then descend to the branches and twigs, "on which they take up their positions, the females, doubtless, to provide for a continuation of the race by developing scales in which to deposit their eggs, and the males to excrete the substance known as white-wax." It is supposed that the wax is intended by nature to protect the scales.

The first appearance of the wax on the undersides of the boughs and twigs resembles snow, but it gradually spreads over the whole branch to a depth of one-quarter of an inch. At the expiration of 100 days from the placing of the insects on the wax tree the deposit is complete. The branches are then cut off. As much wax as possible is removed by hand, but, to secure what remains, the branches are afterward boiled. This boiling of the branches destroys the scales and their larvæ, thus necessitating the bringing of fresh scales the following year from another locality, as above described. A pound of scales, it is said, will produce four or five pounds of wax.

The wax scraped off is put into boiling water, where it melts, and, rising to the surface, is skimmed off and put into molds. Here it solidifies, and the work of manufacture is complete. The insects, which have sunk to the bottom of the pot, are pressed out, and, when the wax has all been extracted from them, are fed to the pigs. A ton of this wax is worth at Shanghai about $1,000.

A tree from which the branches have been removed is not available again for three years. If the wax is left on the tree, the male insects buried under it undergo a metamorphosis, emerging with wings in the autumn and flying away.

This article, in contrast with the deer's horns and tiger's bones above referred to, has an intrinsic value, and not a fictitious one derived from fantastic ideas as to its medicinal qualities. It is, in fact, a substance of great utility in common use in China. It is a clear, white wax, which melts only at a high temperature (160 deg. F.), and is chiefly used to cover candles made of animal and vegetable tallow, to prevent too rapid combustion. It is used in some localities as a sizing for paper and cotton goods, a glaze for silk, and a polish for furniture. It is also said to be used in southern China as a polish for stone ornaments. The above figures of its export give only a partial idea of the proportions of the industry. Immense quantities are shipped from the ports of the upper Yangtse in Chinese junks, and some is sent across the mountains and via the West River to Canton. It is much used there, where I have seen thousands of pounds of it in large round cakes stored away in a single room.

The introduction of foreign [illegible] universally used in China, has had a discouraging influence

** U. S. Consular Report.

on the production of white wax. Kerosene lamps afford a cheaper light than tallow candles, and the constantly increasing use of oil diminishes the demand for wax. This affords but another example of the silent but ceaseless revolution which the entrance of foreigners into China has inaugurated in every branch of native trade. It is possible, however, that a use for this wax may be found abroad to re-establish this interesting and once flourishing industry.

ELECTROLYTIC REFINING OF COPPER.

ELECTRICITY, as is well known, now plays an important part in metallurgy. Electro-metallurgy is already a science in itself, somewhat mysterious in its principles, and having many surprises in store. One of the first uses to which electricity was put in this connection was the refining of copper. The crude copper obtained by the ordinary metallurgic processes contains from 97 to 99 per cent of the metal. The rest is formed of the following substances, in greater or less proportions, according to the origin and treatment: oxygen, sulphur, arsenic, antimony, tin, nickel, cobalt, bismuth, lead, iron, zinc, gold, and silver. These impurities rob the metal of some of the properties that render the use of it so valuable in the industries. Before the ingots of copper are converted into plates, tubes, wire, etc., they have to be refined, that is to say, the proportion of copper has to be brought from 99.8 to 99.9 per cent. The most usual method is to melt the metal and treat it in reverberatory furnaces. Such a method is very difficult of application, especially to arsenical copper. Besides, it has the inconvenience that the gold and silver that almost all copper contains, in small quantities, is lost. Electrolysis, on the contrary, permits of recovering these precious metals, and yields an extremely pure copper, provided the operation is properly conducted. Electrolytic copper is well adapted for electric uses and the manufacture of fine brass designed for cartridge shells.

An electrolytic refining establishment comprises a number of rows of vats of quite large size, in each of which are arranged the 1¼ or 1½-inch thick copper plates to be refined, which are called "anodes." Between these anodes are suspended the "cathodes," in the form of thin plates of laminated or precipitated copper.

All the anodes of each vat are connected together, as are also the cathodes. The anodes of one vat are also connected with the cathodes of the contiguous vat. (See diagram in Fig. 1.)

The vats, which are lined with lead, are filled with an aqueous solution of sulphate of copper, to which sulphuric acid is added.

When the dynamo is set in operation, the electric current passes from the anodes to the cathodes through the electrolyte. Under the action of the current, complex chemical reactions are produced in the liquid and certain impurities of the metal pass into solution in the bath while others become precipitated in the form of sediment. In all cases, the copper is deposited in a crystalline state upon the cathodes. The anodes seem to dissolve and the cathodes increase in thickness so that at the end of a certain length of time all the crude copper has been deposited upon them. The cathodes are then removed from the bath, and have the appearance of warty plates of a beautiful yellowish rose color. If it is desired to make regular plates of copper, these have to be remelted, since, if placed directly in the rolling mill, the grains of copper would be crushed but not welded, and would separate in thin flakes.

After each operation the vats are emptied and cleaned. The water with which the washing is done carries along the refuse that has been deposited upon the sides and bottom. This refuse matter, which is carefully collected, contains the precious metals that have been precipitated in a metallic state by the current. We must add that in order that the operation may proceed properly, the electrolyte must be made to circulate gently from vat to vat through a peculiar arrangement of siphons. After a certain length of time, the bath, which is of a beautiful blue at the outset, becomes dirty and greenish, and is full of impurities. In order that fine deposits may continue to be obtained, it is necessary to regenerate or purify it by physical or chemical means. The solutions employed contain from 1.05 to 1.40 ounces of copper and from 1.76 to 3.52 ounces avoirdupois of sulphuric acid to the quart. The current density is very variable from one establishment to another. In extensive manufacture, it is well to increase it up to the limit at which the deposits become impure. In Europe, 10 amperes per square foot of cathode is scarcely ever exceeded; at Anaconda, in the United States, 20 amperes are employed.

The vats are combined in a series of from 100 to 120. Each absorbs, on an average, 0.23 of a volt. In order to precipitate a ton of copper, it is necessary to employ 20 horse power for 24 hours.

One of the principal inconveniences of this sort of industry is that it immobilizes quite a large stock of copper, the interest on which bears heavily upon the enterprise.

The output of energy is large, and this gives works that have hydraulic power at their disposal a great advantage, when their location does not increase the freight charges out of measure. The net cost of the cathodes is but little over half a cent a pound. On the other hand, the electrolytic copper has a value of but about a cent a pound, on an average, greater than ordinary copper, at least just at present. The operation would not pay very well from a financial point of view were it not for the argentiferous deposits collected as a by-product. In fact, a ton of copper contains, on an average, from 1.1 to 2.2 pounds of silver and from 30 to 46 grains of gold that are not paid for in the purchase of the crude copper, and which constitute in the main the real profit from the refining.

Besides the ordinary refining of copper, some works also manufacture, direct from the raw metal, tubes of electrolytic copper. The following is, in a few words, the principle of the manufacture of tubing as worked out by Elmore, an English engineer: Metal mandrels, into which the current is introduced by brushes, are made to revolve in an ordinary bath between anodes of special profile. As fast as the copper deposits, it is crushed by two small blocks of very hard agate, which move automatically to and fro along the mandrel. These blocks are fixed to a double fork, devised by Mr. Elmore, but since modified and improved upon by Herr Schmitt, superintendent of the Dives works.

After the tubes have attained an adequate thickness, they are removed and turned between three rollers, the helicoidal action of which tends to loosen the very malleable copper from the mandrels. The separation of the metal is afterward effected very easily.

The works at Dives have an electrolytic building 328x196 feet, which permits them to turn out 10 tons a day. Despite the great difficulties peculiar to this sort of manufacture, these works have succeeded in producing, day by day, a copper of truly superior purity having 100 and even 102 per cent of conductivity. In recent years, an endeavor has been made to treat the mattes and ores of copper by electrolysis,

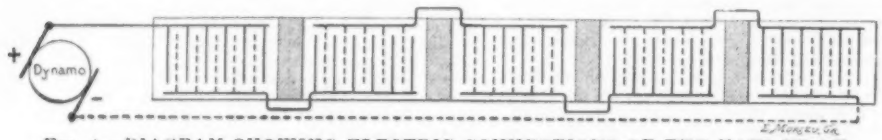


FIG. 1.—DIAGRAM SHOWING ELECTRIC CONNECTIONS OF THE VATS IN AN ELECTROLYTIC REFINERY.

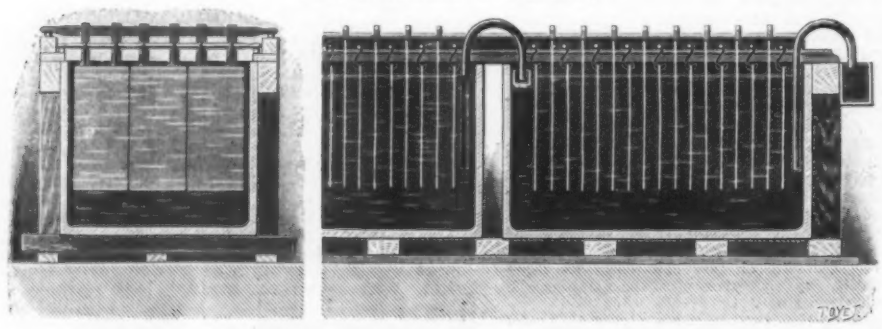


FIG. 2.—ARRANGEMENT OF THE VATS. THOFERN SYSTEM.

FIG. 4.—GENERAL VIEW OF THE ELECTROLYTIC VAT ROOM OF THE DIVES REFINERY, ENGLAND.

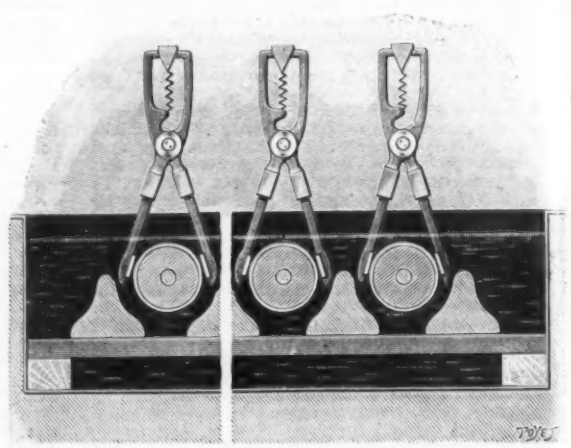


FIG. 3.—SECTION OF AN ELMORE VAT FOR MAKING COPPER TUBES.

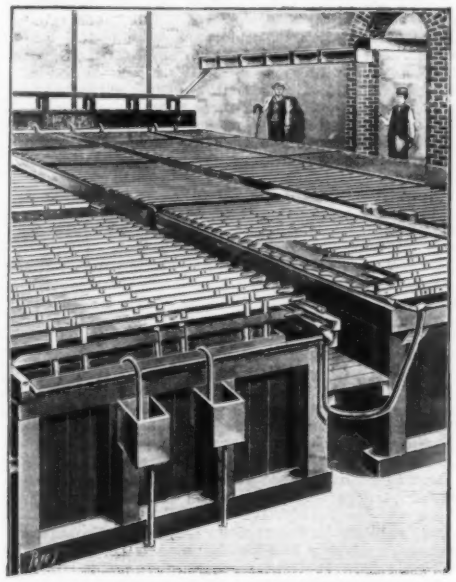


FIG. 5.—MANUFACTURE OF CATHODES.

but the experiments have not given what was expected from them. An application of sulphurous acid to the electrolytic baths, under a patent obtained by MM. Tozzizza, has recently been made, and to this we shall probably have occasion to revert after it has been tested.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from La Nature.

WHERE DO THE PINS GO?

IT takes a good many pins to keep the people of the United States supplied for a year, says the N. Y. Evening Post. The Merriam census figures out that more than seven billion ordinary toilet pins were used in 1900; of hair-pins, 161,000,000 were consumed; to these should be added almost as many more safety-pins.

These figures are derived from the annual production, which is assumed to be about equal to the annual consumption. There is a capital employed in this manufacture of $3,236,158. Most of the factories are in Connecticut. A year's crop of pins is worth $898,054.

The pin has a history which goes back to the Garden of Eden. Its prototype in nature is the thorn. The most ancient relics of prehistoric man are found accompanied by pins, made from bone, ivory, bronze, copper, and iron. From the lacustrine stations in Switzerland alone more than 10,000 pins have been taken, and many have been found in Egyptian and Scandinavian tombs. Among the Anglo-Saxons and Britons loops, ribbons, and hooks and eyes antedated

the pin. Then came silver and other metallic skewers, and finally the indispensable pin.

In early days most pins used in this country were imported, and during the war of the Revolution the price went up to a dollar a paper. They were scarce at that. It was then, and during the war of 1812, that the making of pins in this country began in a very crude way. Dr. J. I. Howe is the father of the American pin industry as we know it to-day. In 1830 he began the study of the problem of pin-making by machinery, and in six years he had a fine plant in operation in Connecticut, making pins for the public and a fortune for himself.

The pin industry created a new demand for stale beer, which is used to clean the pins before they are plated with tin.

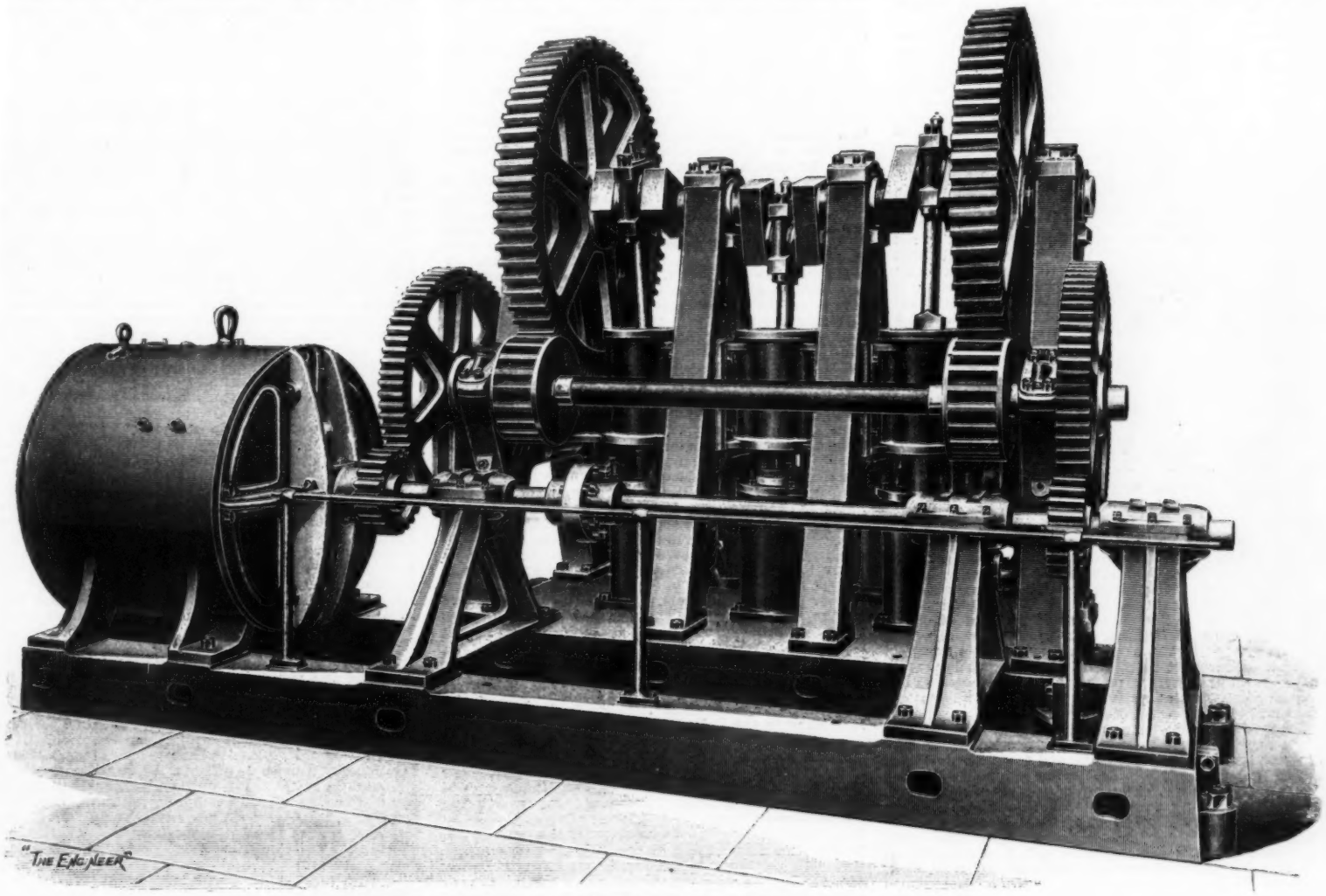
ELECTRICALLY-DRIVEN PUMPS.

WE illustrate from a photograph a set of pumps, constructed by Frank Pearn & Co., Limited, Manchester, for the gold mines of the Cosmopolitan Proprietary Limited, Kookynie, West Australia. These pumps are capable of lifting 25,000 gallons per hour a height of 600 feet vertically; they are driven by an electric motor of 135 brake horse power, making 425 revolutions per minute, and suitable for a voltage of 330.

The pumps are of the three-throw ram type, with rams 10¼ inches diameter, 15 inches stroke, and are connected directly to a three-throw steel crank shaft which is carried by four standards, fitted with gun-metal adjustable bearings. The driving of this is done by two sets of spur wheels, one at each end of the crank shaft; thus the minimum of work is passed through the shaft. The spur wheels are 6 feet in diameter, 3¼-inch pitch, 8 inches wide, and are of cast iron machine moulded. The pinions on the motor shaft are of steel, machine cut, working into cast iron spur wheels, machine cut, which are carried by a steel shaft working in adjustable gun-metal bearings.

The pump barrels are made separate from the valve boxes and are interchangeable.

The valves and seatings are of gun-metal, with suitable doors for access. The ram heads are fitted with loose cast iron crossheads working in cast iron guides of the circular type, to relieve the rams from any side thrust. The connecting-rods are of forged steel, and have marine ends at the crank pin end, adjustable by bolts; the crosshead end is also adjustable. The whole is mounted on a cast iron box baseplate made in suitable sections to suit the size of the mine shaft.—Engineer.



ELECTRIC PUMPS FOR KOOKYNIE GOLD MINES, WEST AUSTRALIA.

To Make a Transparency.—Ordinary printed matter, pictures, etc., on paper may be rendered transparent by the following process: Dissolve very fine white glue in distilled water and apply the solution smoothly and evenly over the face of the picture, using a broad flat camel's hair pencil for applying it. Now lay the paper, face down, on a sheet of glass and press firmly to place. When dry the paper will be quite transparent.—Nat. Drug.

ELECTRICAL CONDUCTIVITY OF CERTAIN ALUMINIUM ALLOYS AS AFFECTED BY EXPOSURE TO LONDON ATMOSPHERE.

PROF. ERNEST WILSON describes results of exposure tests of certain aluminium alloys. The samples had been exposed for thirteen months, and in all cases showed the effect of the weather. It is presumed that the observed effects were principally due to pitting of the surface, although exposure might affect the structure of the alloys. Those alloys containing metals widely separated in the electrochemical series are most affected by exposure. Nickel, when used alone, is considerably affected, but if alloyed with copper the conductivity is found to increase slightly during exposure. This specimen had a breaking load of 45,900 pounds and a low temperature coefficient for electrical resistance, and is thought to be a promising alloy. For exposed light aluminium alloys, the tests show that copper alone should not be used. The presence of equal amounts of copper and nickel reduces the conductivity, but the gain in mechanical and non-corrosive properties is great. Twenty-four samples were tested, and the results are given in tabular form.—Electrician.

COPPER-PLATING METALS BY THE DESSOLLE PROCESS.

IN L'Electricien Mr. H. Fontaine describes a new method of copper-plating iron and steel, which has been developed by Mr. L. Dessolle. A preliminary outline of the various methods which have been tried heretofore is given as it is thought a better understanding of the value of this last process can be had by a comparison. The feature of this method consists in depositing first an adherent coating on the metal to be plated, then transferring to a second bath and completing the work. Adhesion is secured by directing against the article to be plated a strong jet of the electrolyte. This replaces the solution as fast as it is exhausted, and at the same time washes off any adhering impurities or bubbles of gas. The method of applying the new process is described in some detail, and the preliminary preparations necessary for successful work are clearly explained. The object is cleaned either in an acid bath or by sand blast in the usual way. The first bath, which deposits an adhering coating, is made by dissolving four parts of the double cyanide of potassium and copper, 0.5 of pure potassium cyanide and 0.5 part of ammonia in 94 parts of water. The current density employed in this bath is 30 amperes per square meter. After the article has been coated, it is removed to a second bath, which is formed by dissolving crystallized copper sulphate in water, and adding a little free sulphuric acid. By keeping the temperature of this bath at 35 deg. Centigrade, and directing the jets of electrolyte against the surface as described, a current density of 750 amperes per square meter can be used. This will deposit a layer one-tenth of a millimeter thick in fifteen hours. The best that has been done heretofore has been limited to a current density of 10 amperes per square meter, and this gives a deposit of one-tenth of a millimeter in 100 hours. The cost of working the solution varies with the character of the work. For plating tubes inside and out, it is given as approximately five francs per kilogramme of metal deposited. The advantages of this process are discussed particularly in reference to the protection of steam and water pipes on vessels, where it is thought the application will be very valuable.

LONG SPANS FOR OVERHEAD ELECTRIC CABLES.

IT has, heretofore, been considered advisable to shorten the span of overhead electric cables between poles as much as practicable in order to lessen the load upon individual poles, so that it has not been uncommon to have thirty, forty or fifty poles to the mile. While this practice is warranted in some respects, it also has its disadvantages, among which are greater first cost, as well as the subsequent greater cost of maintenance. Unfortunately, also, when a disastrous storm comes, it is not uncommon for one pole after another to fall like bricks in a row, for hundreds of yards, showing that even the highest number of poles now used is not a certain preventive of such collapses. There is also an electrical objection to the multiplication of poles, namely, the lowering of the total insulation resistance of the line thereby, especially in wet weather. It is, therefore, not astonishing to learn that some of the long-distance power transmission companies are seriously considering a radical departure from the conventional practice, proposing to dispense with poles altogether, and in their place to erect large towers, 60 feet high and 1,000 feet apart, on which they would string their heavy conductors 9 feet apart. Assuming that this plan will be found feasible, it is reasonable to assume that the cost of, say, five such towers per mile will not much exceed that of the forty or fifty poles per mile line. With proper precautions the life of such towers should be very long, and the cost of maintenance comparatively low. This proposed departure would not be altogether an experiment, for it was frequently necessary in the early days of telegraphy, and before the advent of submarine cables, to employ long spans of wire to cross rivers and bays. For example, there were several spans of wire over 2,000 feet long across the Elbe and other rivers in Continental Europe, and prior to 1847 the Hudson River, in the United States, was spanned by a number of wires from Fort Lee to Washington Heights, which was then ten miles out of New York city, but is now several miles within the city limits. At that point the river is 2,700 feet wide, and it was the custom to lower the wires into the water to permit ships to pass, for which purpose men were stationed at the crossing. The Mississippi River also was spanned in this way in several places, and at one point where the river was 3,720 feet wide, the wires, No. 16 hard-drawn iron, were supported on masts 307 feet in height.

But there are much more recent instances of the employment of long spans of wire for electrical purposes across bodies of water where, for example, the nature of the bottom or [illegible] rents and ice, make it [illegible] cables, or where, in othe[illegible] on the circuit is greater

in a cable in the present state of the art. Thus, a telephone cable 3,200 feet in length, with ten pairs of conductors, suspended from poles 270 feet high, spans the Susquehanna River, in Pennsylvania; and across Carquinez Straits, in California, the four heavy conductors of a power transmission line carrying current at a pressure of 60,000 volts are strung from iron towers 225 feet in height and 4,427 feet apart.—Cassier's Magazine.

[Continued from SUPPLEMENT No. 1404, page 22500.]

THE UTILIZATION OF WASTES AND BY-PRODUCTS IN MANUFACTURES.*

WITH SPECIAL REFERENCE TO THE DECADE OF 1890-1900.

BY HENRY G. KITTREDGE.

THE LEATHER INDUSTRY.

IN the making of leather very little is allowed to go to waste. In 1896 a patent (No. 13,096) was granted in England for making leather-board material, suitable for being pressed into form for decorative and other purposes, or for use in substitution for leather floor cloth and the like, the waste of leather alone being used. Waste fibrous material and the wax, oil, albuminous and extractive matter derived from cottonseed and shell are made into a pulp, boiled together with silicate of soda, and the whole precipitated by the addition of milk of lime. The alkaline liquor is then drained off from the precipitate. Waste leather or other animal substance is separately treated with sulphurous acid, and then added and thoroughly mixed with the first-obtained pulp, together with tanning agents or chromium compounds. The mass is then made into boards, or pressed or molded as desired.

Among the side products of the tanning of leather may be mentioned the following: Spent tan and tan liquors; waste liquors containing lime salts; scrap and skin for glue manufacture; hair, sold for cheap blanket and cloth manufacture, or for use with lime in plaster; scrap for glue manufacture, and refuse washings. These side products are obtained in the conversion of softened hides into finished sole-leather sides.

Degras, which has been referred to in connection with the woolen industry as being obtained from wool grease, is also a by-product of great value in the leather industry, and a great demand for this material for currying purposes has led to the manufacture of it as a special industry. In this process the skins are treated exactly as in the manufacture of chamois leather, being used repeatedly until no longer capable of taking up the oil. The supply from this source is not sufficient for the demand, hence, an artificial degras is sometimes made from oleic acid, fat, and a little lime soap to which some tannic acid has been added. †

Scraps of leather are now converted by means of a special apparatus into boot and shoe heels, as well as other things, such as inner soles, etc. Some of the small bits of leather are utilized for what is called "shoddy leather," which is made by reducing the bits to a pulp by grinding, and by maceration and conversion into solid "sides" of leather by pressure. This is used to a considerable extent as inner soles for shoes and boots. If leather scraps can not be used for any better purpose, they are utilized in the manufacture of glue. ‡

THE DYEING INDUSTRY.

There are many by-products used in the dyehouse and in the dyeing industry which have contributed largely to the great progress that has been made in manufacturing within the last one or two decades. Of these by-products the most conspicuous and valuable are those obtained from coal tar or gas tar, which, not many years ago, was a waste material difficult to get rid of. It could not be thrown into streams because of its polluting the waters, nor could it be disposed of by burial because of its destructive effect upon vegetation, and had to be disposed of by burning.

These by-products have now become of the highest value, not only for the production of exquisite dyes, but for medicines and disinfectants, and for the production of a saccharine substance several hundred times sweeter than sugar. The list of uses to which these materials can now be converted is a long one. Naphthalene, one of the products of gas tar that was formerly a troublesome waste, choking gas pipes and otherwise making itself obnoxious, is now one of the most valuable substances for the preparation of dyestuffs. The manufacture of alizarin, an artificial preparation of the by-products of tar, has destroyed the madder industry of Europe, or practically so. The aniline by-product of gas tar is a most productive source of coloring matter, its derivatives being almost without number, and producing every shade of color imaginable. By means of a synthetic process, certain constituents of coal tar can be combined for the production of artificial indigo equal in all respects to natural indigo, at a cost that makes it an article of much commercial value. Naphtha is a well-known product of coal tar used in dissolving gums, resinous substances, etc., india rubber and gutta-percha, and for many other purposes. Perhaps the most important products of this tar are benzol, from which aniline colors are obtained, naphthalene, and anthracene, from which alizarin and purpurin are obtained.

The primary object of the coal-tar color industry has been to supplant dyewood extracts by artificial products. The manufacture of synthetic indigo is perhaps the highest attainment yet reached in this line, one involving great scientific research of immense commercial and industrial importance to textile manufacturing. It is thought by chemists that the greatest promise of ultimate success in supplanting dyewoods lies in the development of the azo-dyes as completely as artificial alizarin has supplanted madder. For most purposes, more especially for the dyeing of cotton, the dyewoods may already be dispensed with, since artificial substitutes give superior results and are more easy of application. §

Where dyewoods are used, large quantities of them remain after the coloring matter has been extracted and are thrown away as useless, though this is not carried on to so large an extent now as was formerly the case. In France and in some other of the European countries, this apparently useless product is mixed with tar refuse and formed into compressed cakes for fuel. It is said that a large factory at Havre made at one time such utilization of their spent dyewoods. This firm produced about 120 tons of agglomerated wood per month. The product was distinguished by the relatively small quantity of coal tar (25 to 30 per cent.) which they used, as well as by the low price at which they were able to sell it as compared with other artificial wood fuel. They produced also pyrolignite of iron and wood acids, but afterward gave into other hands the utilization of the waste residues of their manufacture as it tended to interfere with their principal product.*

Before 1870, after concentrating the coloring matter from the dyewoods, less than a dollar per ton could be obtained for the exhausted wood as a combustible, and in most cases it was thrown away as an absolute waste, so far as any use could be made of it for industrial purposes. The rational application of applied science turned this waste into a useful product. M. Chaudet, an ingenious chemist at Rouen, began to utilize this waste in a practical way, and obtained from the exhausted dyewoods various products of a commercial value. One of the most important was a paper pulp obtained by separating the incrusting substances. These, in their turn, combining with the chemical agents by which they were extracted, furnished a useful soda soap adapted to use in cotton printing. It is stated that some of the residual deposits, resulting from the exhausted campeachy and fustic woods, can be utilized in steam boilers for preventing calcareous deposits. The researches of Chaudet led him to discover that the wood of the chestnut and the beech yielded almost colorless mordants, preferable in many respects to those obtained from the ordinary dyewoods. It is claimed that the spent bark of tanneries submitted to a hydraulic press might be employed with equal advantages as an economical fuel and the derivatives made by distillation usefully applied.

The waste liquors in indigo dyeing are capable of being saved and reused. It is reported that at the works of the Pincroft Dyeing and Printing Company, Adlington, Lancashire, England, the waste liquors containing indigo in suspension are passed into precipitation tanks, receiving on the way between 10 and 15 grains of lime per gallon. The precipitated indigo is raised by an ejector from the bottom of the tanks and blown into the different vats to be used again.†

During the fiscal year ending June 30, 1900, there were imported and entered for consumption in the United States coal-tar colors and dyes to the value of $4,792,103.09, upon which duties were paid to the amount of $1,437,630.93.

The production of ammonia from animal matter is insufficient to meet the wants of the present day. Fortunately the deficiency of the supply from this source is met by an inexhaustible supply from the vegetable world, or from the plant life of former periods. In the bituminous coal fields and in the deposits of brown coal is stored up an unlimited supply of nitrogen capable of being converted into ammonia, which is now obtained incidentally in the production of illuminating gas, of coke, and of animal charcoal, the supply depending upon the extent of these industries. This is likely to prove something of an industrial embarrassment, as the consumption of ammonia has grown enormously during the last thirty-five or forty years, while on the other hand the manufacture of illuminating gas, upon which the main portion of the supply of ammonia depends, has been seriously affected by the introduction of electricity for illumination, and is likely to be further affected.

Coke production combined with the saving of the by-products is an established industry in Europe, and is increasing in the United States. The question, Will it pay to gain the by-products of the manufacture of coke? is no longer pertinent. The answer to this question has been practically solved in the affirmative. Coke production is the basis of the tar-color industry, and will further the growth of the soda industry based on the ammonia process. But it is not advocated that the production of coke should be only for the gain of ammonia; the higher yield of coke, the recovery of the tar, with the daily increasing demand for the same, and the gain of the ammoniacal water are the inducements held out by the new methods of production. ‡

A new and interesting development in the chemical industry of the United States is the utilization of the sulphureted hydrogen gas developed as a by-product in the refining of asphaltum at the California Asphaltum Company's works at Ventura, Cal. The gas is burned to sulphurous anhydride in the usual manner, and the product of the combustion conveyed to the lead chambers. Owing to the method of its production, the gas is of a high degree of purity, and the acid produced is also of a high grade. At present the output amounts to 10 tons per day when the works are running at their full capacity. Sulphuric acid is made on a large scale at one other plant, while the manufacture of bluestone and boracic acid, carbonic acid, epsom salts, magnesia, and numerous other products is now carried on. The State of California has great natural resources upon which to base an important chemical industry, and its geographical position gives it an advantage in supplying certain markets of the Pacific slope, so it is probable that such an industry will grow up there when the transportation problem is settled. §

SILK.

There is a large amount of waste made in the manufacture of silk which at one time was considered of comparatively little value. Now the reworking of waste silk has become an important and profitable industry. At the Dublin exposition of 1865, a concern of Milan, Italy, showed some silk waste carded by hand and power, and spun into yarn, that attracted a great deal of attention, and was the subject of interesting comments in the technical journals of that time. Silk-waste carding, however, was not an altogether new industry in Italy, at that period, as there were then 10 or 12 manufacturers, employing upward of 2,000 men, women and children, engaged in this occupation, with an annual production estimated at about 400,000 pounds. At the Paris exposition of 1867 the attention of the French jury was drawn to some exhibits in this line that were made at that time, and interesting mention was made of them in its report.

STARCH INDUSTRY.

There are a number of by-products produced in the manufacture of starches from cassava, potato, corn, wheat, and rice. By-products in the manufacture of rice starch are the rice hulls, which are used mainly as fuel and packing material, but are also ground up and used for the adulteration of spices and the higher grade feed stuffs. As a food product they are of little value, on account of their indigestibility and excessive amount of fiber. Pure rice starch is not made to any great extent, the rice flour being generally sold as rice starch.

Wheat starch is generally made by one of two processes: (A) Wheat flour is made into a dough and the starch washed out in suitable machines, the gluten conglomerating and separating as a tenacious, sticky mass. This is dried and forms the wheat gluten of commerce. It is used as a food article or as a mixing product to raise the percentage of proteids in low-grade feeds. Its utilization is still in its infancy, and its application to the arts is in the experimental stage. (B) Wheat flour is allowed to sour or ferment, and then the starch is separated mechanically on starch runs, the gluten being taken off as a thin fluid, which is generally not recovered. If recovered, it is dried and gives a product similar to that made in process A.

The cassava-starch industry is confined to Florida. The manufacture is still in the experimental stage, and no reliable data are at hand.

For potato starch the potatoes are peeled and ground and the starch washed out and separated by mechanical processes. The by-product is potato slop, which is used as a cattle food in the immediate vicinity, in a wet condition. The potato and cassava industries are of small importance.*

Corn Starch.—About 99 per cent of the starch manufactured in the United States is made from corn, the daily maximum consumption being about 180,000 bushels, yielding 2,500,000 pounds of starch and 4,000,000 pounds of glucose or sugar. From a manufacturing standpoint the kernel consists of four parts: Starch, gluten, germ, and bran, of which the gluten, bran, and germ are by-products. These by-products are separated by mechanical means, the process being somewhat as follows: Corn is soaked in moderately warm water for from twenty-four to sixty hours, to which a very small amount of sulphurous acid has been added to prevent fermentation and to loosen the intercellular tissue between the starch and gluten cells. The excess of soak water is then run off and the wet corn ground in such a way that the germs are loosened without being cut up or broken. The whole mass is then run into separators, where the free germs are floated off as wet germs. These are dried in suitable driers, then ground to a flour and the oil extracted by hydraulic pressure, leaving the corn oil cake as a by-product. This product forms one of the staple cattle foods, and contains about 24 per cent. protein and 10 per cent. fat. The nutritive and digestible properties are very high. Ground oil cake is known as germ oil meal. The average production is about 2 to 2½ pounds per bushel. Over 50 per cent. of it is exported.

The corn mass, free from the germs, is then ground very fine and run over bolting-cloth sieves. Here the bran of the corn is separated and remains on the sieves. The product that remains in the bolting-cloth sieves is pressed, and, combined with about 50 per cent. of water, is sold for immediate consumption. It is known by various names, as "glucose food," "slop," "corn food," "sugar food," etc. It heats and quickly deteriorates in the wet condition, but can be preserved for a time during hot weather by salting. This same product dried is known as "corn bran," "dried glucose," or "sugar food," or some fancy name. The food is easily digested and competes directly with wheat bran. Its composition is about 11 per cent protein and 3 per cent fat. Mixed with the gluten meal described below, it forms gluten food. The yield per bushel is about 4½ pounds.

The substance passing through these sieves, mentioned above, is a mixture of starch and gluten. The starch is separated by gravity from the gluten, the mixture being run over long level planes, as starch tables, runs, or gutters, where the starch settles out as a firm mass and the gluten passes away at the ends. This gluten is settled and gives what is termed wet gluten. The starch taken from the tables is used as the raw material for the manufacture of the various grades of commercial starches, or it is treated with acid and converted into the various grades of glucose or grape sugars. The wet gluten pressed and dried forms gluten meal, the composition of which is, protein 38 per cent., fat 3 per cent., and starch 40 per cent. This is one of the richest and best food products on the market. The nutritive value is very high, and the factor of digestibility ranges from 92 to 96 per cent. The yield per bushel of corn is about 5½ pounds. The gluten meal is treated for the recovery of its starch, and gives two new products, a concentrated food stuff, characterized by the large amount of proteids (60 to 70 per cent.) it contains, and a maltose sirup. This food stuff is suitable for human consumption, and also for raising the percentage of proteids in foods that have a small amount of these substances. When the wet bran and the wet gluten are mixed in the proportions as obtained from the original corn and the mixture dried, the resulting food is known as gluten. This is the most common food product in the starch and glucose industry, and represents about 80 per cent of the food output. Its feeding value is very high and its digest-

* Census Bulletin 190.

† Industrial Organic Chemistry, 3d edition, S. P. Sadtler, p. 335.

‡ Waste Products and Undeveloped Substances, P. L. Simmonds.

§ Chem. Zeit., 20,

* Waste Products and Undeveloped Substances, P. L. Simmonds, p. 219.

† Journal of the Society of Chemical Industry, January 31, 1896.

‡ Dr. Bruno Terne's address before the chemical section of the Franklin Institute, Philadelphia, October 30, 1891.

§ The Engineering and Mining Journal, 1899.

* Bulletin No. 58, Department of Agriculture. The Manufacture of Starch from Potatoes and Cassava; by W. H. Wiley, Ph.D.

ibility above 90 per cent. Its composition is about 28 per cent. protein and 3 per cent. fat.

Corn oil cake and gluten meal are exported extensively. The bran and gluten food is used almost exclusively in the United States. The production per bushel of corn is about 12½ pounds of food, giving a maximum daily production of from 1,200 to 1,300 tons, valued at $25,000.

OLD RUBBER.

Old rubber as a waste material is a thing of the past. Nothing containing rubber is discarded, but is utilized in some form of commercial utility. One thing that formerly rendered rubber comparatively valueless was because of its being vulcanized, which rendered it of little use for remanufacture, due to the fact that it could not be remelted for mixing with new gum because of the sulphuric treatment it had received. This difficulty is now overcome, and the old rubber is blended with the new in certain proportions with good results, enabling the manufacturer to reduce materially the price of his goods. Old rubber can be utilized, however, without being mixed with new material, by being steamed, passed between rollers and in this softened condition applied to a strong, coarse fabric, or used for such purposes as stiffening the heels of boots.

In 1890 (United States Patent No. 420,820) a patent was granted to N. C. Mitchell, of Philadelphia, for a process of restoring rubber, with special reference to the treatment of rubber waste, such as old boots and shoes, for the purpose of recovering therefrom the rubber as a marketable product. By this process the old stock, after being ground between rolls and freed from foreign matters, such as metal, sand, and fiber, is exposed to the action of heat, preferably steam heat, for the purpose of devulcanizing and desulphurizing the rubber. The steam acts mainly in softening the rubber and has but little effect in removing the sulphur. The inventor of the process discovered that desulphurization may be effected by mixing with the rubber small quantities of sulphide of calcium previous to the treatment with steam. When calcium sulphide is used alone, a very high degree of heat is required to effect desulphurization, which high degree of heat dries the rubber to an injurious extent. It is therefore desirable to mix with the calcium sulphide some substance which will keep the rubber in a moist condition. For this purpose heavy petroleum is used, usually in the proportion of 7 pints of the mixture of petroleum and sulphide calcium to 200 pounds of rubber scrap. Seven pints of the fluid contain one-fourth of a pound of the sulphide.

BREWERIES.

A patent was taken out in England in 1897 (Patent No. 3,900) for a process to utilize the solid refuse of breweries, distilleries, starch and sugar factories, and the like. In the process described the refuse is treated with soda lye, and the pulp produced mixed with different kinds of finely powdered resins. The lye is then washed out with water, the remaining water is pressed out, and the residual mass is dried in a vacuum drying apparatus and finally pressed in molds while warm. The material is then claimed to be ready for use as laths, panels, wall coverings, etc.

The exhausted mash-tun grain in breweries is used for cattle food, and, while containing too much protein to be used alone, it is regarded as a most valuable food when mixed with hay. The amount of dry grains produced in breweries in the United States is estimated at 300,000 tons a year, and is all sold for cattle feed. Some breweries collect the carbonic-acid gas, that results in the process of fermentation, for soda water. There are consumed in the neighborhood of 50,000,000 pounds of hops annually in the United States in the manufacture of beer. These hops when they become exhausted are a veritable waste, and are buried or thrown on the refuse heap.

TIN AND MUSSEL SHELLS.

Among the materials used in the production of buttons are the remnants of the sheets of tin plate from which the bottoms and caps of cans for blacking and other boxes have been cut. After the button blanks have been punched from these tin remnants, the scraps which are left are made into sash weights. Another article that was considered of little or no value ten years ago is the fresh-water mussel shell, which is now extensively used in the manufacture of buttons. These shells were used in the button industry of the United States in 1900 to the amount of 4,830,112 pounds at a cost of $238,046.

GLASS.

Broken glass is now being utilized in the manufacture of artificial stone as a building material, which has been tested in France with apparent satisfaction. The material is known as ceramic stone. The broken glass is first ground to a powder, and then devitrified by passing it through two furnaces, the second at a very high temperature, when the pasty mass is pressed, thereby acquiring form and solidity.*

ASHES, ETC.

An artificial stone is said to be made in Germany of sifted ashes, potash, and other alkaline carbonates, gypsum, and slaked lime. It is said that this stone is not affected by atmospheric conditions. This mixture of sifted ashes and other materials is mixed with diluted sulphuric acid and hydrated sulphate of lime, forming potassium sulphate, which dissolves, leaving a plastic mass of gypsum to be molded by compression into the desired forms. To remove any alkali that may remain in the stone, it is immersed in a solution of alum acidified with sulphuric acid; and the alum is decomposed and alumina formed, and this still further hardens the stone.†

CORN PITH.

Among the uses of waste products may be mentioned the application of the pith of the cornstalk to naval and military uses for the protection of vessels, forts, or other structures from the injurious effects of collision, projectiles, or otherwise. Efforts have been made from time to time, for many years, for some means of readily and effectually closing openings made in the hulls of vessels by collisions or projectiles. Different substances have been proposed, and some have been adopted, that have proved more or less serviceable.

Masses of cork or other light material have been used, extending to the water line of the vessel, so that in the event of the place being pierced by shot, no more water could enter than would fill the place traversed by the shot, and thus the buoyancy of the vessel would be but slightly interfered with. The amorphous cellulose of the cocoanut has been used with advantage as a barrier or cushion to protect vessels, forts, and other structures. The discovery that a material can be prepared from the pith of cornstalks, which possesses in a high degree all the qualities desired, was made by Mark W. Marston, of Philadelphia.* He found that this substance had a capacity to absorb water or moisture of over twenty times its own weight, which exceeds the absorptive capacity of any known substance capable of like uses. Further, the rapidity with which the water is absorbed by this substance is said to be greater than that shown by any other; thus a compressed body of this material will absorb water to fully one-half its capacity, or ten times its weight, almost as soon as water is brought into contact with it. The inventor found that if the substance were dried after being saturated, it substantially returned to its former condition and acted as before on again being wet.

GLYCERINE.

In the manufacture of soaps a large portion of the glycerine contained in the oils and fats employed, passes into the salty lye which is left at the end of the operation. A method has been suggested † for recovering from this waste, glycerine in a sufficiently pure condition for commercial purposes, ready for use without further treatment. The method employed consists in first treating the lye with an acid to neutralize partially the free alkali of the solution, and then to add sulphate of iron or sulphate of aluminium to complete the neutralization, and the precipitate is filtered or otherwise separated out. Evaporating is then employed to crystallize out the salt, and finally the resultant liquid is distilled to obtain the glycerine.

The wash resulting from the distillation of wine, molasses, beet root, and, speaking generally, from any alcoholic fermentative, contains glycerine, which is formed during the alcoholic fermentation at the expense of the sugar. A process of recovering the glycerine from these residues is a recent invention of a Frenchman.‡ The process consists in concentrating the wash by evaporation and treating it with an agent to neutralize the free acids contained therein, then subjecting the wash thus treated to the action of steam to carry off the glycerine contained therein, and finally condensing the glycerine. Aside from obtaining glycerine from the residues left from the distillation of wines and similar materials may be mentioned other by-products, such as ammonia, tars, and salts. A process for the utilization of distillers' wash is the subject of another French invention patented in this country. §

PRINTERS' INK ROLLERS.

There are now improved means of utilizing waste portions of printers' ink rollers, which have heretofore possessed but little commercial value, for the recovery of glycerine from the residuum of a process of distillation. ‖

POWDERED MILK.

The manufacture of powdered milk has become in late years an industry of considerable importance. The main difficulty heretofore has been that milk could not be shipped to countries where it was scarce, owing to the fact that even in the condensed form it would keep but a short time. In very hot climates it is almost impossible to use condensed milk, as, after a can is opened, it has to be consumed almost immediately. Condensed milk also contains a large percentage of sugar and water, which add to the expense of freight. In powdered milk there is no water and absolutely no foreign matter, no chemicals being used in the process of manufacture. The product is made from sweet skimmed milk, by a process of simple evaporation. Not until lately, it is believed, has a milk powder been manufactured which would remain soluble, owing to the action of the heat upon the albumen, but in the process now in use the heat is so regulated that there is obtained a perfectly soluble product with almost no odor, and by adding the required amount of hot water a perfect skim milk is obtained. This solution may be precipitated by rennet in the same way that ordinary skim milk is precipitated, or, if allowed to stand for some time, it will sour in the same manner.

CORN OIL.

Corn oil is a valuable by-product of breweries, distilleries, and starch works. It is adapted for illuminating purposes, and the claim is made that it may be advantageously used for dressing wool, and also as a machine oil, and in the manufacture of soap. It might, in certain cases, be applicable as a lubricant, its low acidity and little tendency to deposit solid matter or to "gum" being properties that recommend it for this purpose. Donard and Boulet, at their works at Bapaume-Les Rouen, France,¶ have treated during the last seven years about 28,000,000 pounds of corn cake, from which 7,700,000 pounds of oil were extracted. Corn oil is the most valuable product obtained from the corn kernel in the manufacture of starch, being worth more than the main products—starch, glucose, or grape sugar. Corn oil can be treated with sulphur (vulcanized), giving a product similar to rubber, which is used to mix with rubber for the manufacture of all kinds of rubber goods. The oil itself is used in paints. It is a nondrying oil, very stable, and does not become rancid. The characteristic taste and smell are eliminated through refining. Seventy-five to 80 per cent of this oil made in the United States is exported.

The maximum daily production of corn oil in the United States is about 275,000 pounds, worth $16,000. The value of the by-products, feed and oil, is about 20 cents per bushel of corn.

LONDON AIR AND LONDON FOG.

THE Rev. John M. Bacon discusses in Knowledge the vexed question of London fog. "As to the far travel of London smoke," he says, "when it is not detained in fogs over the city, there is plenty of evidence forthcoming. In days of bright sunshine in the open country the fairest and most favored suburbs of the west end may be partially over clouded if an east wind causes London smoke to set in that direction. This same smoke may be actually seen at thirty miles to leeward, and when it drifts away as London fog it may be smelt for twice that distance. . . . It was on a calm clear night last summer that I made a night voyage over London, starting at 3 a. m. With gradually increasing altitude, Fulham was crossed, then the suspension bridge at Battersea, next Lambeth and Peckham, and so out over Kent. As far as could be discerned, London proper at all heights was as free from smoke as can be conceived, but when the town was left far in our wake our course took us over some cement works, whose chimneys were pouring volumes of smoke into the sky. This smoke, however, as viewed from our level of 4,500 feet, seemed to rise no considerable height anywhere into the atmosphere; on the contrary, it rapidly spread into a low-lying layer, and then traveled outward without sensible thinning away as far as the eye could reach. At twenty miles distant it was on the earth, still making itself unpleasantly manifest. . . . As to what may be observed from the highest accessible point of St. Paul's, I can record some experiences. On many days of moderate fog you may be able to climb above the actual fog limits, but in the exceptional fogs preceding last Christmas this was not so. Under these circumstances what are the actual dimensions and conditions of the fog? In one of the early numbers of Knowledge, Richard A. Proctor points out by mathematical reasoning, depending on the amount of light that even in densest fogs actually does struggle through from the clear sky above, that the depth of the fog layer cannot be very great. And this seems probable on every account. Particles of carbon, being good radiators, must readily reach the dew point, and becoming heavy with deposition of moisture, must in circumstances of fog be incapable of rising high into the atmosphere."

THE STUDY OF THE UPPER ATMOSPHERE.*

THE ascensions of manned balloons and kites have proved latterly an important means of exploring the atmosphere. Consequently, meteorology should rejoice in this method of observation and manifest its interest by making use of the results. There is no doubt but that the employment of such aids became more necessary, when, through the foehn phenomena, meteorologists first recognized the importance of ascending and descending currents and noticed that the formation of clouds has as close a relation to the rising currents as has the fine weather to the descending currents. Of the physical changes that are going on around us in the atmosphere, a general theoretical picture could be gained, but the deeper understanding of the phenomena required that the observer, or at least his instruments, should follow the rising and sinking air currents and so furnish more exact conclusions about temperature and humidity. Precisely for the solution of questions relating to the vertical currents, the new methods of scientific aeronautics have rendered important services and have given an insight into the mechanics of the phenomena that could not be gained in any other way. However, all preceding results are only beginnings and here, as in other branches of knowledge, it has proved to be the case that every fresh investigation raises new questions; in this case the relation of these vertical currents to whirls of air, stratification, etc. Earlier investigators had already perceived the importance of aeronautics for meteorological researches. When Charles, the inventor of the hydrogen balloon, made his first ascension in 1783, he took with him a barometer and a thermometer, as did the American aeronaut Jeffries, who ascended from London during the next year. It was only until very lately that Germany took part in this work, or about the year 1880, but then with an instrument markedly superior, namely, Assmann's aspiration-psychrometer, and through the munificence of the German Emperor she was enabled to carry out the work on a large scale. For the second time the representatives of scientific aeronautics now meet on German soil and thereby recognize the importance of our efforts. But much indeed has been done for this new research by M. Teisserenc de Bort at Trappes, near Paris, through the perfection of the *ballon-sonde*, the unmanned balloon carrying self-recording instruments, and by Mr. Rotch, of Blue Hill, through his application of kites. Both methods are so good that by their use a great impetus has been given to meteorological research, whereby it is easily understood that there should be uniform rules for their employment. Looking backward it may be said that the international meetings for the organization of meteorological research, in 1854 at Brussels, in 1873 at Vienna, and 1879 at Rome, are landmarks in the progress of the science, and that when, in September, 1896, the International Committee for Scientific Aeronautics was appointed, the plan had been so well considered and the technical necessity was so evident that there was entire unanimity in the deliberations and resolutions. The originator of the idea of the unmanned balloon was the late Gaston Tissandier, who enthusiatically explained the scheme to the speaker in 1886, although nearly ten years elapsed before its realization. This work will be fruitful, for wind and clouds have no political boundaries and the sun belongs to us all. Consequently, we are all striving, for various reasons, toward the same goal, and the motto *viribus units* will be, as ever, the decisive measure of the result.

* Journal of the Society of Chemical Industry, vol. 16, p. 44.
† English patent 20612. 1897.

* United States patent No. 534611. 1895.
† United States patent No. 458647. 1891.
‡ United States Letters Patent No. 631396. 1899.
§ Letters Patent No. 669811. 1901.
‖ United States patents Nos. 675821 and 649169.
¶ Journal of the Society of Chemical Industry, vol. 16, p. 550.

* From a paper read by Prof. Dr. von B[illegible] nautical Congress.

PYTHON SWALLOWING A SUCKLING PIG.

THERE are few people that have not at one time or another been present at the feeding of snakes at a zoological garden or exhibition, and witnessed with amazement how these reptiles kill and gobble up animals whose size apparently is in no proportion to the slight width of the snake's jaws. The faculty of the snake to swallow comparatively large animals with one gulp, is due to the extraordinary flexibility of the jaw apparatus. The lower jaw of the snake is not, as in other vertebrate animals, hinged in the upper jaw at the skull and movable only in a certain direction, and to a limited extent, but the lower jaws are connected by elastic bands and the jawbones and palate bones are jointed at the skull. Now, in order to dispatch the morsel, which is made slippery with plenty of saliva, down to the œsophagus, the palate bones are set with hook-like teeth bent backward to prevent the prey from slipping back. The exceedingly mobile ribs have no breast bone in the front and permit of the greatest expansion of the interior of the trunk; in short, the entire structure of the snake is equipped for this sort of feeding. Snakes eat very rarely, and only go for live animals. Venomous snakes kill their prey by the bite; other serpents, especially boa constrictors, which are non-poisonous, crush their victims to death. We distinguish two kinds of giant snakes: the boas, confined to America, and the Old World pythons. While, despite all the "Indian stories" of the boa-constrictor attained a length of fifteen feet, there is not one authenticated case where this snake has killed a child, not to speak of a full-grown man, nevertheless numerous instances of this kind are known to have occurred in Asia as well as Africa with pythons. The python excels the boa in size, although the statement of the soldiers of Regulus in the first Punic war that they had a python of 123 Roman feet in length is doubtless exaggerated. It is a fact, however, that pythons have measured eight to nine feet. In attacking its prey the python first grasps its victim with the fangs, turns itself around it, the tail firmly wound around a tree, and crushes its ribs and spine. For the digestion of its food—and the snakes probably have the best digestion among all animals—it often requires many days. In the state of satiety the snake is perfectly helpless and can be easily killed. From the skin of the python the natives make articles of clothing and all sorts of other objects.

PYTHON SWALLOWING A SUCKLING PIG.

Our illustration from India shows a python which has swallowed a suckling pig and now lies perfectly helpless during the process of digestion.

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Für Alle Welt.

THE "FIEND-FLY."

IN Knowledge the "bug-proper" in its old formations is described by Mr. E. A. Butler. The first creature analyzed is "a little creature of such weird aspect that one can scarcely be surprised at its having been associated by country folk with the powers of darkness. Its scientific name is *Centrotus cornutus*, and among the peasantry of France, its dark color combined with the sinister appearance of its foreparts has gained for it the sobriquet '*Le Petite Diable*,' while an English author speaks of it and its relatives as 'Fiend Flies,' and an American entomologist describes them as 'Brownie-bugs.' When viewed in front it seems to show a brownish black vertical face surmounted by a pair of curved horns, and this was quite enough in mediæval days to suggest a Satanic association. But it is not really the head to which this formidable appearance is due. The head in fact is neither very large nor conspicuous save for the rather large and wicked looking eyes; but the prothorax has taken on the most grotesque form, rising perpendicularly above the head, surmounting it as with a head dress. This head dress runs out into the aforesaid horns at the side, while between them there is a little ridge which, if we follow it backward, we see gradually extending and enlarging till it forms a long sword-like appendage reaching nearly to the end of the body, and looking like a sort of stiff puggaree to the aforesaid head gear."

. . . Another insect of the order "frog-hopper," "has a head shaped like a miner's shovel, running far forward as a thin and flattened triangular plate, scooped out in the middle of its disk, slightly rounded at the edges, and turned up at the tip. This leaf-like appendage is slightly transparent, and is often prettily marked with a series of blackish mottlings which give it somewhat the appearance of black lace. The wings when closed are placed along the sides of the body in a nearly vertical position, and their surface is in some instances more or less plentifully sprinkled with minute blackish dots, as though it were slightly dusty. The large compound eyes are situate in the hinder part of the head and the curious shovel-like plate passes right in front of them, and in fact bisects their surface, leaving part of each eye above and part below its level. One would think that this arrangement must interfere with vision, at least in the forward direction, though no doubt the insect has an unimpeded range of view on each side. The exact shape and size of the shovel part of the head varies a good deal, so much so indeed that different names have been assigned to the different forms under the belief that they were distinct species. However, as it is possible to find large and small heads, as well as intermediate ones, in the same batch at the same spot, it seems more probable that all the differences of form are mere variations within the limits of a single species. It is impossible to say what is the reason for this curious conformation of the head. Practically nothing is known of the habits of the insect, save that it lives among low plants, grasses and the like, especially in dry sandy places."

MINERAL PRODUCTION OF THE UNITED STATES IN 1901.

THE volume of Mineral Resources of the United States for the Calendar Year 1901, David T. Day, Chief of Division, now in press, United States Geological Survey, presents an interesting and valuable summary of the mineral production of 1901, as compared with the corrected statistics for other recent years.

In 1901, for the second time the total value of our mineral production exceeded the enormous sum of $1,000,000,000, the exact figures being $1,086,529,521, as compared with $1,063,620,548 in 1900, and with $972,152,208 in 1899, a gain of 1901 over 1900 of $22,908,973, or 2.15 per cent and a gain of 1901 over 1899 of $114,377,313, or 11.77 per cent.

The notable gains and losses of the last two decades are as follows:

The largest actual gain was that of 1899 over 1898, $273,601,810, or 39.17 per cent; next that of 1900 over 1899, $91,468,340, or 9.41 per cent; then the gain of 1895 over 1894, which was $94,215,822, or 17.88 per cent, and the gain of 1887 over 1886, $74,927,880, or 16.81 per cent. In other years than those mentioned between 1880 and 1898 the gains were not noteworthy, and in some of the years, notably in 1884 the production decreased $40,451,968, or nearly 9 per cent. During the industrial depression of 1892-1895 the production would have been expected to decline, as it did, going from $648,895,031 in 1892 to $574,464,724 in 1893; to $527,079,225 in 1894, and then rising to $621,295,047 in 1895, and not reaching the output of 1892 until 1898.

As heretofore, iron and coal are the most important of our mineral products. The value of iron in 1901 was $242,174,000, as compared with $259,944,000 in 1900, and the value of coal was $348,910,469, as compared with $306,671,364 in 1900.

It is to be noted that the total amount of time lost from strikes in the coal industry in 1901 was only 733,802 working days, as compared with 4,878,102 working days lost from strikes in 1900, with 2,124,154 days thus lost in 1899, and with something like 20,000,000 working days thus far lost in 1902 from the same cause.

All of the important metals decreased in both output and value, with the exception of the production of pig iron and zinc, and among the less important metals the most remarkable increase both in quantity and value was made in platinum: 1,408 ounces valued at $27,526, as compared with 400 ounces valued at $2,500 in 1900, a gain of 1,001 per cent in value. The fuels increased from $406,359,351 in 1900, to $442,395,304 in 1901, a gain of $36,035,953, or 8.87 per cent. Every variety of fuel increased in value except petroleum, which showed an increase in quantity of 5,768,665 barrels, but a decline of $9,571,978, due largely to the less valuable character of the increased product of the new petroleum fields as compared with the older fields. Anthracite coal increased 9,021,207 long tons in output and $26,746,169 in value. The average price of anthracite coal per ton at the mine was $2.05, the highest figure obtained since 1888, as compared with $1.85 in 1900 and $1.80 in 1899; and the average price per ton for bituminous coal at the mine was $1.05, about one cent more per ton than in 1900.

The gain of $22,908,973 is due entirely to the increase in the non-metallic products, since the metallic products showed a decline from $550,425,286 in 1900 to $518,268,377 in 1901, a loss of $32,156,909, whereas the nonmetalic products increased from $512,195,262 in 1900 to $567,261,144 in 1901, a gain of $55,065,882. To these products should be added estimated unspecified products, including the rare minerals, lithium, tungsten, vanadium, uranium, etc., bismuth and crystalline quartz, valued at $1,000,000, making the total mineral production for 1901, $1,086,529,521.

For the first time since 1885 the production of bismuth in the Uniterd States is noted in this report. The manufacture of arsenious oxide was taken up for the first time in the United States, in 1901, by the Puget Sound Reduction Company at Seattle, Wash., when an output of 300 short tons was placed on the market. For the first time also, in 1901, the production of rutile on a large scale was realized by the American Rutile Company from the deposits in Nelson County, Va., whose output amounted to about 40,000 pounds.

THE CANDIED FRUIT TRADE OF PROVENCE.

A PARTICULAR commercial specialty in Provence is that of preserving fruit in sugar, classified in French as "fruit confits," which is carried on with greater success than anywhere else in the world. The most successful houses engaged in this business are located in the little town of Apt, in the center of a rich and protected corner of Provence, where many kinds of fruit and vegetables are grown, and shipped to the Paris and Marseilles markets. It has been stated by one of the most prominent of the Apt manufacturers that, although he has experimented repeatedly in the United States and elsewhere with fruits of various kinds, he had failed to secure satisfactory results anywhere except in Provence. Consul-General Skinner states that this same manufacturer has a branch house in New York, where certain supplementary operations are carried on for the American trade, and he is familiar with the fruit grown in California and Louisiana. He says that the fruits of the States mentioned, although attractive to the eye and agreeable to the taste in a fresh state, lack the consistency of the French fruits, and thus cannot be subjected to the repeated boiling and scouring which are essential to the manufacture of a translucent and perfectly finished product. This is particularly true of the cherries, from which it is difficult, if not impossible, to extract the stones without a small portion of the flesh of the cherries adhering. Even in France, the area within which satisfactory fruit for this business may be grown is restricted to the neighborhood of Apt. Thus, for example, the apricots of Roquevaire, also in Provence, which are shipped in very large quantities in the form of pulp to important canning houses, cannot be preserved in sugar, retaining their natural form, color and flavor. The process of manufacture at Apt possesses no particular mystery, but is carried on with great patience under the direction of men who have inherited generations of experience. All the fruits intended for preservation in sugar, upon arrival at the factories, are placed in hermetically sealed chambers, upon shelves permitting the free passage of sulphurous fumes. In this chamber about one pound of sulphur per 4,000 kilogrammes (8,800 pounds) of fruit is burned, and the chamber is kept closed for two hours. The effect of the sulphur is to brighten the fruit, give it a uniform transparency, and remove black spots and superficial imperfections. This operation terminated, the fruit is plunged into boiling water maintained at a temperature of 100 deg. Centigrade (212 deg. Fahrenheit), in which it remains for from twenty to sixty minutes. This operation is known as the "bleaching process," the purpose of which is to remove the last remaining natural acid and render the fruit absolutely pure. After this thorough boiling, it is removed and placed in fresh water, in order to harden the flesh, and it remains in this water, which is constantly renewed, for from twenty-four to forty-eight hours, according to the nature of the fruit. The raw material is by this time quite ready for the preserving process proper. It is first placed in boiling sirup daily for a period of about two months. There are ten different operations connected with this branch of the process, which results in the concentration of the sirup and guarantees the complete preservation of the fruit. The fruit is con-

tinued in sirup until the moment for packing and forwarding arrives, when it is removed, washed in water, and finally crystallized, an operation which consists in again plunging the fruit into sirup with boiling sugar, where it remains for ten hours. With this final sugar bath, it is considered that the fruit can be delivered with entire security to the public. It is well understood that the use of sulphur is of no importance in so far as the real merit of the finished product is concerned; but on the other hand, there is no doubt that it renders it much more attractive to the eye.—Journal of the Society of Arts.

RECENT DISCOVERIES OF THE MISSIONE ITALIANA IN CRETE.

SINCE the famous discoveries of Schliemann and those of Doerpfeld and Tjoundas at Troy and in Greece, the chief contributions to the solution of the problem of pre-Hellenic civilization have been the discoveries made by the English at Cnossus and by the Italians at Festo. Students all over the world have been surprised by the discovery of a series of new documents so numerous and important as to throw considerable light on questions relating to the origin of European civilization and to the history of the first man that inhabited the eastern shores of the Mediterranean. To Italy belongs the glory of having contributed largely to the elucidation of these questions, the discoveries of the *Missione Archeologica Italiana* being among the most noteworthy of modern times. The work was done by a company of intelligent, active and enthusiastic young men from the Italian School of Archæology under wise and able guidance. The successful explorations on the island of Crete have been followed by those in Montenegro and Egypt, and still others are planned for Cyrenaica. In addition to the success of these expeditions from a scientific point of view, many practical results of the greatest importance have been attained.

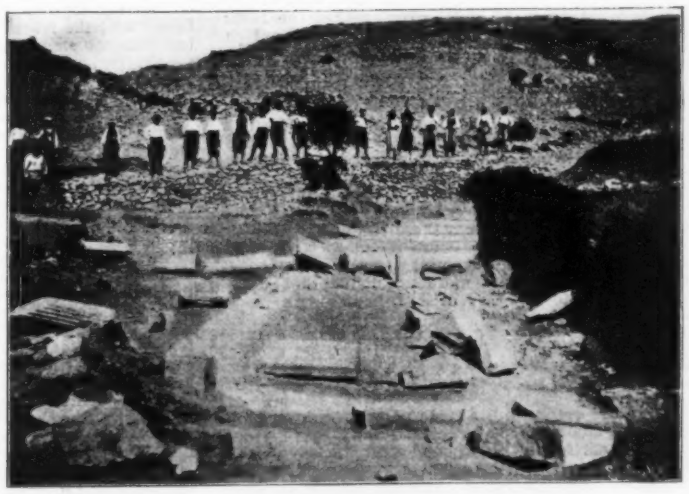
The work of the *Missione Archeologica Italiana*, which preceded that carried on at Festo or was contemporaneous with it, should receive the appreciation it deserves; for instance, the city of Gortina, which was second only to Cnossus as the most important center of Hellenic life and was the most important center of Roman life on the island of Crete, was carefully explored, two campaigns being devoted to work on the agora and the large Roman theater near the Leteo, within the walls of which were incorporated that ancient code of laws, "Leggi di Gortina." Another campaign was devoted to the temple of Apollo Pitio and the Byzantine church near by—constructed almost entirely of old material—and a fourth to the temple of Æsculapius at Lebena, where the ancient inhabitants of Gortina had a sanitorium, and to a port of Gortina on the Libyan Sea. There were also expeditions to other localities with which communication was generally difficult, where the conditions of life were trying and malarial fevers raged.

In former archæological campaigns the *Missione Italiana*, besides reorganizing and consolidating the work already done at the palace of Festo, completed the exploration of the area about the palace, discovering rich halls with pavements of alabaster and walls covered with the finest stucco on which flowers and fascia were painted in bright colors. They also discovered baths in the apartments for the men as well as in those of women; and the results of work under the palace were most important, showing as they did that it had been built on the ruins of a still more ancient edifice. Here they found a series of storehouses full of pots and jars of terra cotta of most remote origin, and also an opening containing a very old table for refreshments. The fact that the locality was inhabited at a very remote period was established by the discovery at a considerable depth of articles of chipped or polished stone and the remains of bowls which belong to the latter part of the stone age; so that from the neolithic era to the Roman period four civilizations left their traces and their documents at Festo.

It was thought that there must be a necropolis near the palace, and the first uncertain attempts to find it were given an impulse in the right direction by the accidental discovery, by a peasant, of some very ancient funeral paraphernalia. Excavations were made where these objects were brought to light, and tombs were found which were merely little chambers cut out of the rock, some of them being provided with domes These tombs contained skeletons and bones, and a rich collection of bronze articles, nearly all of which were broken, including mirrors, knives, large pins, arrowheads, etc. Especially worthy of mention were two swords—one of which had a hilt which is richly wrought and plated with gold—and many vessels of bronze and terra cotta fashioned in various and elegant forms. In these tombs were also many ornaments, such as necklaces or collars of glass, stone and gold; heads of pins, and beautiful rings; also hard stones on which various characters had been carved. This search was extended to different localities and resulted in the discovery of many tombs with terra cotta urns shaped like coffins and belonging to different periods; and while these finds indicated that the rite of burial was almost universally used, in one place there were evidences of cremation.

STATUE OF ROMAN SENATOR DISCOVERED IN THE AGORA AT GORTINA.

EXCAVATION IN THE AGORA AT GORTINA.



EXCAVATION AT LEBENA—THE PORTICO.

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from L'Illustrazione Italiana.

PREHISTORIC CIVILIZATIONS OF AMERICA.

BY EDUARD SELER.

[PROF. SELER, who holds the chair of American Antiquities in the University of Berlin, journeyed to the United States to attend the sessions of the International Association of Americanists, which were held in this city recently. Prof. Seler is probably the greatest living authority on American antiquities, and he is the first scientist to decipher correctly the picture writings of the ancient peoples of Mexico and Central America. He dictated the following article, giving his views on the probable origin of prehistoric American civilizations.—The Independent.]

It is known that when the Spaniards first came here they found in the Southern territory of the United States a mound building people. In certain mounds there have been found various articles of European origin. From this discovery it is evident that at least part of the mounds date after the coming of both Spanish and English to America. Nevertheless, it is also true that other mounds antedate the coming of the Europeans.

An opinion first brought out by the late Charles Rau, of the Prehistorical Department of the National Museum in Washington, was that the mound builders were an identical people with the Indian tribes conquered by the Europeans. This opinion was shared by Cyrus Thomas, of the Smithsonian Institution, who directed the field work of exploring the mounds in various States.

My opinion is the same. In certain mounds of the Southern States only have there been found articles, that in conception and handicraft, appear superior to those that we know have been made by recent Indians. These articles are, for instance, disks cut from shells and from metal engraved with geometric signs, representations of serpents and spiders, and illustrations of men holding in their hands figures of slain enemies. Certain traits in these figures strongly remind one of ancient Central American art.

Judging from these and more elaborate remains, it may be that before the arrival of the Europeans there lived in the Southern States tribes, now extinct, that had a higher form of culture than we know of. Perhaps there existed a connection between these tribes and the ancient people of Cuba and Haiti. The late Frank Cushing, when conducting the Pepper-Hearst expedition in the mangrove swamps of the coast of Florida, found wooden masks painted with different colors, and an assortment of other very curious relics. Evidences brought to light in these swamps reveal a comparatively high state of culture for Indians. Furthermore, it seems that there existed in prehistoric times some trade between the tribes of Cuba and Haiti and those of the peninsula of Yucatan, because when Columbus first landed on these islands he was told of a land rich in gold and that the people of this land wore clothes. The land spoken of must have been Yucatan, since the natives of Cuba and Haiti wore no clothes at all.

The old languages of the ancient tribes of Cuba and Haiti have not been studied as they ought, for the main reason that there are few remains of these languages extant. There might be brought out a similarity of connection between the Maya language of Yucatan and the idioms of the ancient people of the Antilles and those of the northern coast of South America.

I do not share in the opinions advanced by French authors that the mound builders emigrated from the United States to Central America. I incline to the opinion that the Toltec, Aztec and Maya cultures originated in the region where we find them in Mexico.

Where the various prehistoric peoples originally came from no one knows. I do not think they came from Asia in comparatively recent times. Man is very old in America, I think; perhaps he antedates the glacial period. The cultures of the prehistoric peoples bear no trace of being imported either from Asia or Europe. Neither their architecture nor science, such as it was, nor their customs, were brought here from other countries. Nor is there any proof that there existed any relations even between the ancient Peruvian and Maya cultures. The architecture of these ancient peoples bears no resemblance to anything we know of in the Old World. In prehistoric Mexico many exact astronomical observations were made. The period of Venus was known, and the length of the solar year, which was reckoned, as now, at 365 days, and they had certain methods of intercalation, in order to make concordant this inexact reckoning with the true length of the solar year. We must suppose, unless proofs of the contrary should be brought forth, that this scientific knowledge, as, indeed, the whole state of civilization of those peoples, was developed by themselves without any hint of information from Asia or Europe. The people in Mexico, Yucatan and in the other places where a high state of culture obtained were crowded; their very necessities made them keener of mind and more progressive than other tribes of Indians elsewhere, whose agriculture was primitive and whose life was nomadic.

The great question now among archeologists is whether the Aztecs were the teachers of the Maya or the latter the teachers of the Aztecs. This question is not wholly settled, but it is beyond question that there are many points in which these cultures coincide.

The Mexicans had a tradition of a primitive people called the Toltecs, whose king and god was Ketzalcouatl (Snake of the Green Fathers), who was afterward revered as a wind god. The Toltecs, so goes the tradition, were the originators of all civilization and culture, especially of all the industry, such as working in gold, precious stones and feathers; of religion and scientific knowledge, and particularly of the calendar. These people, the Toltecs, the tradition ran, were driven out of their homes and their god exiled with them by the machinations of a sorcerer called Tezcatlipoca (the Smoking Mirror), who, too, was afterward venerated as a god and, in fact, was one of the principal deities of the Mexicans. The Toltecs, continues the legend, emigrated in the direction of the rising sun to Natiuh Iixco—that is to say, from the central highlands of Mexico to the Atlantic Coast, where, it is said, their descendents are living now.

This tradition was treated by the late Prof. Brinton as wholly mythical. I do not share in this opinion. It seems to me that the different traditions touching the Toltecs indicate the fact that they were a people of Mexican parentage that emigrated to the Maya region —Yucatan and Guatem

It is a fact that at o
Mayapan and Chichen-I

It is also a fact that to the present day there are great groups of Mexican people living in Guatemala, San Salvador and Nicaragua, who, in those regions, are called Pipil (Princes or Sons). It is my opinion that the old Toltecs gradually went down the coast to Yucatan and the surrounding country, and that the greater part of their descendants were submerged in the Maya population of that region.

I am induced to that opinion from the fact that the particular traits of Maya culture cannot be expiained in any other way than by comparing them with the traits of the Mexicans at the time of the Spanish Conquest. The Mexicans, for instance, had a calendar constructed upon the basis of twenty signs and thirteen numerals. The Maya had the same. But I think that neither the hieroglyphics nor the names of Maya day signs can be explained without going back to the ancient Mexican forms. In ancient times there existed a great commercial road going from the highlands of Central Mexico to Tabasco and Yucatan, and to the Rio Montagua in Guatemala. Along this road it seems there had sprung up commercial centers where the Mexicans met the Maya traders. Jade, an article more valuable in that day than diamonds to-day, was much trafficked in in these centers; though, by the way, no one has even found where the ancient Mexicans obtained their jade. It is a great mystery. It is the opinion of geologists that jade was found only in small pieces in river beds, and that these depositories were searched diligently by the ancient peoples, who made of the finding of jade a great art.

As I have said, the knowledge of erecting their superb edifices, of making astronomical calculations, of weaving clothes and fashioning metals and many other things—this knowledge, it is my opinion, was developed without contact with any people in Europe or Asia.

GOLD MINING IN EGYPT.

HUNDREDS of European and American tourists, in pursuit of health or pleasure, now travel on the Nile, between Cairo and Assouan, every year; and, since the destruction of the Dervish power in the Soudan, Wady Halfa and Khartoum have attracted many visitors. Thus the valley of the Nile has become as well known as any part of Europe; yet, within a few miles of the river, on either side, lies what is practically an unknown land. The sandy waste seen from the river, beyond the belt of cultivation, to the eastward, in no way represents the whole country between the Nile and the Red Sea. At Keneh, in lat. 26 deg. N., the sandy zone, which forms the true desert, is but 20 miles wide, while in the latitude of Assouan it is fully 150. To the east of this, and bordering the coast of the Red Sea, is a chain of lofty and rugged mountains, 50 miles wide, several of whose peaks attain an altitude of 8,000 feet above the sea, and the general altitude of the divide of the watershed is from 1,500 to 2,000 feet. It is this belt of mountainous country that forms the gold-mining district of Egypt.

The most striking physical features of the country are the usually dry water-courses, known as "wadies." These take their rise in the mountains, and run down on either side to the Red Sea or to the Nile. In its upper part a wady usually resembles an ordinary torrent-bed, but gradually develops into a long, flat, winding water-course, with cliffs of rocks on either hand, sometimes 200 feet in height, and a bed of sand and pebbles, in which all the lithological constituents of the neighborhood are represented. At times, during the copious rains which fall in the mountains in the spring and autumn, these wadies are converted into rushing rivers, which carve out great holes in their beds and banks, and leave their marks on every side. Usually, however, they are only good, hard, sandy roads, with some small trees and plants, which form meager but useful grazing for camels. Toward the Nile, on the west, and the Red Sea, on the east, the wadies gradually lose themselves in the sands of the lower districts, and probably little, if any, of the water which they bring down ever reaches the river or the sea on the surface. The crystalline rocks, which constitute the mountain districts to the east, are of the oldest geological series met with in Egypt. The larger mountain masses are usually formed of a hornblendic granite, with pink orthoclase, which gives the whole a strikingly red appearance when seen from a distance. Surrounding these, in the lower ranges, and covering very extensive areas, is a rather fine-grained gray granite passing in several places into gneiss, and that into mica schist, traversed by dikes and intrusions of greenstone, felsite, porphyry, and a very fine-grained white, elvan granite. It is in these rocks that most of the auriferous quartz veins were found to occur, and the more the granite was cut up by the intrusive rocks the more frequently and more promising the quartz veins appeared to be.—C. J. Alford, in Cassier's Magazine.

WHEN COAL WAS CURRENCY.

By F. E. SAWARD.

ONE of the queer things made of coal is an ancient coinage of money. The articles termed Kimmeridge coal money are found only in one locality, in the pseudo-isle of Dorsetshire. W. Miles, who constructed a very ingenious hypothesis on the subject, attributes these obscure relics to the hands of the Phœnician artists, and regards them as representatives of coin, and of some mystical use in sacrificial or sepulchral rites. These curious articles are found in two secluded valleys, open to the sea, divided by an intervening ridge of considerable elevation, and known as Kimmeridge and Worthbarrow Bays. These bays are in the wildest and least frequented part of Purbeck, where the plowshare is scarcely known, and the scanty population, retaining many primitive characteristics, lives remote from the busy world. The material of which the coins are formed is a bituminous shale, of which an extensive bed exists on that part of the coast. It has been much used in the neighborhood as fuel, and is still in request by the inhabitants for that purpose. It burns freely with a white ash and slaty residue, and diffuses a disagreeable bituminous odor over the apartment in which it may be consumed.

In form, these coal moneys are flat, circular pieces, with beveled and molded edges, from 1½ to 2½ inches in diameter and from ¼ to ⅝ of an inch in thickness. The accuracy with which the circular form is preserved and the sharpness of the moldings—even after the lapse of many ages—show that the pieces were turned in a lathe. They have on one side two or three or four round holes, apparently for fixing the point of a chuck, and on the other side a small pivot hole. In a few instances these round holes are absent, and the pieces are wholly perforated with a single central square hole, so that the piece may be fixed on a small, square mandrel head—another circumstance which proves that the people who made these articles were well accustomed to the use of the lathe. These antiquarian problems are discovered beneath the surface, at depths varying from 5 to 18 inches, or occasionally perhaps at a still greater depth. In some spots they are more numerous than in others; in one instance, upward of thirty pieces were dug up within the compass of about a square yard. They are frequently brought to light in some numbers in the construction of drains for the purpose of bringing the land into cultivation. They are generally found at the bottom of the superior stratum of mold, irregularly scattered about, and having no appearance or association to indicate an intentional and careful deposiure. Of the substances with which the coal money is found associated, the first place must be assigned to fragments of pottery. The coal money is frequently found mixed with small flat pieces of stone, having each but a few inches of surface.

A British author writes of the unearthing of a piece of sculpture cut out of bituminous shale during some excavations at Silchester, in Hampshire. Looking up the evidence in the Public Library, I find that for several years there have been carried on explorations of a buried Celtic city with the above name. It makes most interesting reading. It is Britain's Pompeii on a small scale, but having—it is computed—about double the antiquity of the Italian city. Among the three-thousand-year-old treasures which have come to light was the coal statue, representative of the human figure from head to groin. There are no legs and probably the sculpture was made without them. The material of the statue is spoken of as bituminous shale, but there is no evidence to show it was not artistically cut out of some kind of timber (like the totem poles of our Pacific Indians), and in the course of thousands of years, buried beneath the surface, had become petrified. However, the archæologist of to-day writes of them as a bituminous shale. This is another illustration of the omniscient utility of coal. The old Celtic word for these coal sculptures is "ogam." Its literal meaning is "man of power." The word alone would explain the raison d'être of the statue. There is a line extending from the lips to the center of the body, with numbers of irregular cross lines the entire length. Reference to the Century Dictionary shows that these unequal lines on the coal ogams are inscriptions to the memory of the dead "man of power"—being in language power what the hieroglyphics were to the Egyptians. In later centuries the coal-ogam inscriptions were preserved by the Celtic tribes as a secret cipher. The ever-useful bituminous shale was even found to have been used in making the scholars' school slates of 3,000 years ago. Merchants' daybooks were dug out, also made of shale; likewise scales and stamps.—New York Times.

THE WORK OF GEORGE GRAHAM—AN UNKNOWN ASTRONOMICAL CLOCKMAKER.

AN interesting account of an ancient and ingenious triumph of horological science and skill, to which no reference can be found in any of the standard works upon horology, has been published in London. It relates to the work of George Graham, who died in 1751 and who invented the dead-beat clock escapement, which even to-day is considered to be the most reliable and accurate escapement for timekeepers. During the latter part of his life, Graham devoted his researches almost exclusively to the production of astronomical instruments, and the most remarkable of these was a regulator showing on two dials sidereal and mean time respectively, both sets of hands controlled by a pendulum beating mean time seconds. This original movement is still to be seen, and is in splendid condition, having been most providentially spared from the hands of a repairer. To make an ordinary regulator indicating sidereal seconds, it is only necessary to make the clock gain 3 minutes 56.5564 seconds per day; but to show the two times from one movement controlled by a pendulum vibrating mean time seconds, requires a knowledge of mathematical calculation and ingenuity in the mechanical arts rarely combined. Graham's instrument is a marvel of mathematical ability, and was constructed with artistic skill, for after one year's performance it only showed an error of 3½ seconds. That is, he made one set of hands showing 86,400 sec. drive hands showing 86,636.5564 sec.—an interesting problem for the lover of mathematics, and a very difficult one for the practical mechanician. The train of the clock movement is very similar to the usual form of regulator movements. It has a dead-beat escapement controlled by a compensation pendulum, known as the gridiron, the expansion of the steel rod of the pendulum being counteracted with rods of brass. The two sets of hands have the usual motion. The day of the month is shown in the usual manner, through the slot in the dial; but by an ingenious device the calendar is made to correct itself for those months that have only thirty days, and for February, which has but twenty-eight days. It is evident from this piece of work that Graham struggled hard to gain perfection, for he made the calendar wheel change itself for leap year, and thus show twenty-nine days in February. The mechanism is entirely different from that of the modern perpetual calendar work. Its action may be concisely described as follows: The revolving calendar wheel has thirty-one teeth, and is moved one tooth every twenty-four hours; a star wheel having twelve teeth is carried round by the above wheel, having pins projecting from its face which engage with a lever during those months which have thirty days. This lever then comes into contact at the end of the month, so that two teeth are moved, and thus the figure 31 is not shown. During February the lever is kept in contact for three teeth, so that the figures 29, 30, 31 are not shown. A small star-wheel having four teeth is carried on the small star-wheel having thirteen teeth, but is moved only one tooth each year; this wheel alters the lever slightly once in four years, and causes the figure 29 to show during February in leap year.

WHY COAL IS WASHED.

THE purpose of washing coal is to free it as nearly as possible of all matter that reduces its heating capacity or has a detrimental effect upon the metal produced with such coal or with coke made from such coal.

The impurities of coal are of two kinds, such as are chemically passive, but which do not produce heat, but, on the contrary, absorb heat and clog the openings in the grates by forming ashes and clinkers; they must be repeatedly handled, shipped and freight paid for them and are a burden all around.

The other kinds of impurities are chiefly iron pyrites, an ore composed of iron and sulphur, containing as much as 53 per cent. of the latter element. There occurs also frequently some phosphorus, which remains in the ashes. The sulphur and phosphorus are both injurious to the quality of iron produced in a blast furnace and for this reason it is very important that coal or coke for blast furnace use shall be as free from these two elements as possible. The phosphorus occurs in the ash producing matter, and remains there unless it is given an opportunity to chemically combine with iron, lime or other matter for which it has an affinity.

The value of furnace coke is based, apart from general chemical reason, upon its degree of purity from ashes, sulphur and phosphorus.

The effect of sulphur and phosphorus is to make iron brittle. Iron containing these elements in excess of certain limits is unfit for all purposes in which strength is an important requirement.

There is economy in purifying inferior coal, even for ordinary heating purposes, for not only are ashes an impediment to the rational use of fuel, but the sulphur of the pyrites emits fumes which eagerly combine with what moisture there is in the coal and form sulphurous acid, which exerts a destructive influence upon all iron, as boiler shells, tubes, breechings and slack, that it touches.

For blacksmith purposes, also, washed coal is far superior to coal in its natural state, because the tendency to form clinkers is very much reduced by the process of washing.

Lump coal is much purer than nut coal and slack. Until about fifteen years ago slack had barely any value in the Youghiogheny region, on account of its large proportion of impurities. Consumers did not want it, and it could be shipped only by rail, which was too expensive; it became a burden at many of the mines, and anybody could have had it who cared to take it. Yet that same slack, when properly washed, produces a coke equal to any of the Connellsville region. At some of the Monongahela mines slack was sold in large lots at the tipple at 10 cents per ton.—Mines and Minerals.

PHOTOPHONIC BOOKS FOR THE BLIND.

By V. DE TURINE.

A SHEET of transparent paper contains, printed upon a black background, a number of small white squares, separated from each other by intervals one, two, or more lengths of a square in size. These squares, together with the intervals, represent the letters of the alphabet, exactly as do the dots and dashes of Morse. In order to enable the blind to read these letters, the printed sheet is placed in a frame between two thin plates of glass fully exposed to the light, and an opaque piece of cardboard, or some other material, with a square-shaped opening in the center, is moved by the reader along the printed lines from left to right. Whenever the opening passes over one of the white transparent squares, the rays of light illuminating the printed sheet pass through this opening, and, by means of a photophonic apparatus, are changed into sound. In this way, the blind reader receives the letters in the form of sounds separated by longer or shorter intervals of silence, and his ear fulfills the functions of the eye. There exists a great variety of photophonic devices that can be used for transforming the rays of light into sound for the purpose above stated. Thus the light may be made to impinge upon a plate of selenium intercalated into a circuit fed by a galvanic battery, so that whenever the light falls upon the selenium and permits the currents to pass through it, a slight sound is caused in an electro-magnetic apparatus attached to the circuit. Or a Wheatstone bridge may be used, fed by an alternating or intermittent current, the generator of which is situated in one of the diagonals, while the other contains a telephone, and a plate of selenium is intercalated in one of the branches, the bridge being so balanced that the telephone remains silent as long as no light falls upon the selenium, while the moment that the latter is illuminated it emits a sound. In a third method a differential telephone fed by alternating or intermittent currents is used, which, in one of its circuits, contains a plate of selenium; the two circuits being so balanced that the currents neutralize each other, and no sound is heard as long as no rays of light impinge upon the selenium. These methods and many similar ones will be quite suitable for the desired object. Instead of photophonic devices based on the characteristic qualities of selenium, others may be used resembling the apparatus of Mercadier, in which the diaphragm of a microphone is covered with lamp-black and serves as the bottom of an air-tight box, the cover of which is a glass plate. The microphone is intercalated in the circuit of a galvanic battery, which also contains the primary of an induction coil, the secondary of which is connected with a telephone. The light falling upon the blackened diaphragm produces, as in the case of selenium, the conditions required for the absence of sound in the telephone.—Ecl. Electr.

SELECTED FORMULÆ.

Cement for Leather.—

Glue	1 ounce
Starch paste	2 ounces
Turpentine	1 drachm
Water, a sufficient quantity.	

Dissolve the glue in sufficient water with heat; mix the starch paste with water; add the turpentine, and finally mix with the glue while hot.—Drug. Cir. and Chem. Gaz.

Acid-Free Polish for Leather.—Rub up from 90 to 120 parts of lampblack, 15 parts of boneblack and 350 parts of syrup (molasses will answer) to a homogeneous mass. In another vessel gently heat 15 parts of finely chopped-up gutta percha over a coal fire, until it begins to melt, and run together; then, under constant stirring, add, little by little, 25 parts of cottonseed oil, and continue the heating and stirring until the gutta percha is dissolved. When this occurs, add 5 parts of stearin and stir till dissolved. Now add the still hot mixture, under constant agitation, to the mixture of syrup and blacks, and work into a homogeneous consistence. Finally, dissolve 20 parts of senegal gum in 60 parts of water and stir the solution well into the mass.—Drug. Cir. and Chem. Gaz.

Soap for Cleaning Silver Plate.—

Cocoanut oil	80 parts
Soda or potash lye, 38 deg. B.	40 parts
Water	10 parts
Ammonium chloride	1 part

Heat the oil and lye together until saponification takes place; dissolve the chloride in the water and stir the solution into the soap mixture. Let the whole come to a boil, then remove from the fire.—Drug. Cir. and Chem. Gaz.

To Silver-Plate Britannia.—According to the Journal der Goldschmiedekunst, it was formerly deemed necessary to cover britannia metal with a layer of copper as a preliminary to silver plating it. The process has, however, been very much simplified, the copper bath being entirely done away with. The metal is now simply plunged into a hot saturated solution of crude potassium carbonate and the plating is then done directly, using a strong electrical current. The potassium carbonate solution it seems, dissolves the surface of the britannia metal and thus enables the silver to take a strong hold on the metal.—Drug. Cir. and Chem. Gaz.

Improved Carmine Drawing Ink.—The ordinary solution of carmine in ammonia water, after a more or less short time in contact with steel becomes blackish red, but an ink may be made that will retain its brilliant carmine color to the last by the following process, given by Dingler: Triturate one gramme of pure carmine with fifteen grammes of acetate of ammonia solution, with an equal quantity of distilled water in a porcelain mortar, and allow the whole to stand for some time. In this way, a portion of the alumina, which is combined with the carmine dye, is taken up by the acetic acid of the ammonia salt, and separates as a precipitate, while the pure pigment of the cochineal remains dissolved in the half-saturated ammonia. It is now filtered, and a few drops of pure white sugar syrup added to thicken it. A solution of gum arabic cannot be used to thicken it, since the ink still contains some acetic acid, which would coagulate the bassorine, one of the constituents of the gum.—National Drug.

Sodium Cacodylate in Ocular Affections.—Galezowski (in Receuil d'ophthalmologie) reports having frequently used, with excellent effect, cacodylate of sodium internally, in certain affections of the eye, notably in inveterate hepatic keratitis. He had, however, used it more frequently as a topical application in the shape of an oily or aqueous collyrium, as follows:

Sodium cacodylate	15 cgm
Cocaine hydrochlorate	25 cgm
Liquid vaselin	15 gm

Mix. Signe—Instill a few drops two or three times a day.

Black Ink.—

Tannic acid	23.4	grammes
Gallic acid	7.7	grammes
Ferrous sulphate	30	grammes
Diluted hydrochloric acid	25	grammes
Carbolic acid	1	gramme
Acacia	10	grammes
Water enough to make	1000	grammes

—Drug. Cir. and Chem. Gaz.

Ink for Zinc Labels.—For writing on zinc, the following, which appeared originally in the Helfenberger Annalen, has proved excellent:

Potassium chloride	60 parts
Cupric sulphate	120 parts
Anilin blue	1 part
Dilute acetic acid	100 parts
Distilled water	1,800 parts

Dissolve the potassium chloride and culpric sulphate in 1,400 parts of water. Mix the acid and the remainder of the water, and in the mixture dissolve the blue. Mix the two solutions.—National Druggist.

Wild Cherry Balsam.—

Wild cherry bark	1 ounce
Licorice root	1 ounce
Ipecac	1 ounce
Bloodroot	1 drachm
Sassafras	1 drachm
Compound tincture of opium	1 fl. ounce
Fluid extract of cubeb	4 fl. drachms

Moisten the ground drugs with the fluid extract and tincture and enough menstruum consisting of 25 per cent alcohol, and after six or eight hours pack in a percolator, and pour on menstruum until percolation begins. Then cork the orifice, cover the percolator, and allow to macerate for twenty-four hours. Then percolate to 10 fl. ounces, pouring back the first portion of percolate until it comes through clear. In the percolate dissolve ½ ounce of ammonium chloride and ½ pound of sugar by cold percolation, adding simple syrup to make 16 fl. ounces. Finally, add 1 fl. drachm of chloroform.—Pharmaceutical Era.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Automobiles in Asia.—

BRITISH INDIA.

Consul W. T. Fee writes from Bombay: The automobile industry at this port and generally throughout this consular district, which is co-extensive with the western half of India, is quite in its infancy. There are, probably, not more than a half dozen automobiles in the district—one of American make, one made in Bombay, and the balance either English or French importations.

Tariff.—The duty on automobiles imported from any foreign country into India is 5 per cent ad valorem.

Market Conditions.—The streets of Bombay are excellent, as are generally the main roads throughout India. They are thoroughly macadamized, or metaled, and made smooth by heavy rollers. Constant attention is given to them, uneven places are filled up, and all small, loose stones are removed from the surface. India being a tropical country, there is no freezing to upheave them; hence they wear smooth and solid.

Horses are generally imported, and the climatic conditions are very trying for them; therefore, I may safely state that few countries offer more attractions for the use of automobiles than does India, and they will doubtless, in a short time, come into as general employment as the bicycle of to-day.

Styles.—As to the kind and styles of automobiles best suited to India, I would urge our manufacturers and exporters to carefully study the conditions of the country and needs of the people.

Electricity is not in general use in western India, and until the cities are lighted by it and it becomes common as a motive power in tramways and factories, making supply stations more numerous, the inconvenience of recharging the storage batteries of the present electrical automobile would be so great as to forbid its introduction. These local conditions will certainly soon be changed, and when they do, the electric automobile is the kind that will win favor in India.

After consulting a number of probable importers of the motor car and those who have given the subject some study, it would seem that the automobile best suited to India would be that propelled by gasoline, capable of carrying two or more persons, with a canopy, or, better still, a victoria top as a protection against the rains and the rays of the tropical sun. This is necessary in India. It should also have a seat extending in the rear, or a step, to provide a place for a "syce" (a native servant). It should be strongly built, with as little complication as possible.

A high rate of speed is not desirable; 12 to 15 miles per hour, at the most, is probably all that would be ever required, and it should be capable of climbing ordinary grades.

The price would be a controlling feature in its sale; it should be as low as is consistent with quality and durability.

Most of the hill stations or resorts in India are located on high elevations, varying from a few to 40 miles from the railroad station, and, while the roads are metaled and generally good, the present means of transportation are usually very inferior. At such places there are inviting openings for the automobile, to be used by individuals and for public conveyances.

Gasoline.—Gasoline retails in this city for about 20 rupees ($7.50) per drum of 8 imperial gallons. It is imported by the Standard Oil Company, of New York, in steel drums, and is called "petrol," or "motor spirits." Being classed by the local government as an explosive, a license is required, at a cost of a small fee, if it is used in quantities larger than 1 gallon.

Steam Motors.—There is quite a sentiment here among motor-car people in favor of the automobile with steam as a motive power, generated by kerosene as a fuel. Kerosene is about as cheap and as common in India as in America, owing, no doubt, to the strong competition of American, Russian, and Burma oil in the market. The steam (kerosene fuel) motor cars would have in their favor this strong point of reasonably cheap fuel.

Importers.—The following named concerns are giving their attention to the importation and sale of the automobile. I add to the names, respectively, the kind of motive power of the automobile handled:

The New York Export and Import Company, of Cedar Street, New York city, with a thriving branch on Hummum Street, Bombay; kerosene and electricity.

J. A. Kirkbride & Co., Tamarind lane, Bombay; kerosene and petrol, or motor spirits.

Vatcha Brothers, Girgaum, Bombay; steam motor.

F. B. Thanawalla, Kalbadevi road, Bombay; electricity.

Turner, Hoar & Co., Elphinstone circle, Bombay, handle the "Reading motor car," a steam automobile, adapted to burn kerosene oil for fuel, using the Clarkson & Capel oil burner.

The Motor Transport and Supply Company, agents for Shaw, Wallace & Co., of Calcutta, propose establishing an agency in Bombay for the kerosene-fuel steam automobile.

CHINA.

Consul John Fowler, of Chefoo, says: Outside of the foreign settlements of Shanghai, Tientsin, Hankau, and possibly one or two other smaller ones, I doubt if a carriage of any description could be used on the streets and roads of Shangtung; therefore there is no market in this district for automobiles, nor do I think that there will be for a long time to come.

Consul H. B. Miller reports from Niuchwang: The tariff on automobiles coming into Manchuria through Niuchwang would be the regular Chinese duty of 5 per cent. If brought into Port Arthur or Dalny, they would come in free of all duty.

It is possible that a few might be sold in Dalny, Port Arthur, or Harbin, to Russians.

Kuntz & Albers, at Dalny, Port Arthur and Harbin, or the American Trading Company at Dalny or Port Arthur, would be the best agents.

STRAITS SETTLEMENTS.

The following has been received from Consul-General O. F. Williams, of Singapore:

The cities of Singapore and Penang are the only large towns in this colony, and both are on islands made more or less rugged by mountains or high hills, Singapore rising to 519 feet and Penang to 2,724 feet, thus being inaccessible in parts to vehicles.

Singapore Island contains only 225 square miles, and but 6 per cent of this is redeemed from primeval jungle; and much the same may be said of Penang.

There are in Singapore two automobiles, not much used, and much abused. Recently, the Sultan of Johore—who has residences here and also across the straits in Johore—brought a large automobile from Europe; but it is very noisy, and complaints are increasing against it.

A great number of jinrikishas are in use in every city and town of the colony. Last year 19,414 jinrikishas were licensed in Singapore alone, and as each license runs for four months about 5,000 of these man-drawn carriages are in constant employment. In the entire colony, there are only some 460 miles of improved roads and nearly one-half are in the cities, leaving about 230 miles of rural roads.

In the Federated Malay States, under the governmental tutelage of Great Britain, good roads are few. In Selangor, rich Malays and Chinese own a few automobiles, but they are simply fads. In the Federated Malay States, the principal industries are tin mining and lumber cutting. General agriculture is limited, and the bull cart is the common vehicle.

Tariff.—So far as customs duties are concerned, all ports are free to imports. The only duties collected are on exports, usually 10 per cent ad valorem.

I do not think conditions favor trade in automobiles in this colony or its dependencies.

Alcohol from the Jerusalem Artichoke.—The price of combustible alcohol in France is nearly double what it is in Germany. In the latter country, it is chiefly the Irish potato that furnishes alcohol, while in France it is the beet root. The cultivation of the former costs nearly double that of the latter.

In commenting on these facts, a French writer recently called attention to a tubercle much neglected in France, much more rustic than the Irish potato, and of great saccharine richness—the "topinambour," or Jerusalem artichoke. It is easy and inexpensive to cultivate; it is not affected by dryness or dampness; it has no maladies; and it can be harvested when desired. In the most ordinary soil, the writer says, it will produce 300 quintals (66,138 pounds) of tubercles per hectare (2.471 acres); yielding 25 hectoliters (660.425 gallons) of alcohol at 20 francs ($3.86) a gallon, or a total of 500 francs ($96.50). The value of the by-products of these 300 quintals is also worth mentioning: 130 quintals (28,659 pounds) of pulp, excellent for fattening cattle and worth—valued at 2 francs (38.6 cents) the quintal—260 francs ($50.18); the leaves, about 70 quintals (15,432 pounds), in the form of ensilage, make a splendid fodder; the 3,000 to 4,000 stems when dried furnish a good fuel. It is stated that these by-products, if economically utilized, will almost pay the expense of culture, leaving the alcohol to bear only the expense of distillation. This alcohol can be substituted for oil in domestic and industrial uses, and the writer goes so far as to say that its cheap production will enable it in the future to compete with coal.

If this is true, it should prove a boon to French agriculture, for the coming harvest is the last one unaffected by the agreements made at the Brussels sugar conference—agreements which, if carried out, will virtually destroy beet-root culture in France.

Surely the suggestions herein given are worth a trial in America.—Thornwell Haynes, Consul at Rouen.

Florida vs Polynesian Phosphate.—Under date of October 22, 1902, Consul Kehl, of Stettin, says: It is possible that Florida phosphate will meet a serious competitor in the recently discovered deposits on Ocean Island, northeast of the Solomon Islands, which seem to be superior in quality to either Florida or Christmas Island phosphate. The following analysis was furnished me by the director of the largest local chemical works and importers of the American rock:

Description.	Florida. Per cent.	Christmas. Per cent.	Ocean. Per cent.
Tribasic phosphate of lime	70.95	83.08	86.15
Oxide of iron and alumina	2.2	1.83	.68

Local statistics for the year 1901 show an importation into Stettin of 101,156 tons of phosphate, of which 70,341 tons were from the United States.

The time required in making the passage from Christmas or Ocean Island to Stettin is fifty-five to sixty days, while from Florida it is twenty to twenty-two days, depending upon the speed of the steamer. The difference in freight rates is said to be about 9s. 6d. ($2.30) per ton.

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The Reports marked with an * [illegible] in the SCIENTIFIC AMERICAN SUPPLEMENT. Reports by application to Bureau of Foreign Commerce, State, Washington, D. C., and while the supply is exhausted,

TRADE NOTES AND RECIPES.

New Furniture Polish.—The Oesterreichische Farben und Lack-Zeitung gives the following:

White wax	2,500 parts
Water, distilled	4,500 parts
Potassium carbonate	25 parts
Oil of turpentine	4,000 parts

Boil the wax in 1,500 parts of the water, carrying the potassium carbonate, until the wax is saponified. Add sufficient water to replace that lost by evaporation and stir till cold and add, little by little, under constant agitation the oil of turpentine, and continue to stir until a complete emulsion is attained. When this occurs add the remainder (3,000 parts) of water all at once and stir in. In case the mixture is incomplete add a little more oil of turpentine. Perfume with lavender oil.

To use the cream smear a little of it on a thin soft rag and with this go over the furniture, then polish with a woolen cloth, or bit of flannel. The cream answers equally well for leather upholstering, imitation leather, leather cloth, marble, etc.

Cloudy Ammonia.—The following formula for "cloudy" ammonia" has been published:

Water of ammonia	1 pint
Soft water	8 pints
Good yellow soap	4 ounces
Potassium nitrate	1 ounce

Cut the soap into shavings and dissolve in the water with the aid of heat. When the mixture is cool dissolve in it the potassium nitrate. Strain, and when the mixture has settled, skim, add the ammonia, and bottle at once.—Drug. Cir. and Chem. Gaz.

To Coat Metals With Glass.—To cover metallic objects with a glaze that is all but everlasting, proceed as follows. Break up about 125 parts of ordinary flint glass, add 20 parts of sodium carbonate and 12 parts of boric acid; melt together. When melted pour out on a stone or metal slab, let cool and pulverize. Now make a mixture of this powder and a water glass solution of say 50 deg. B., apply to the metal surface and heat in a muffle until the surface fuses. No very great heat is required, and the glazing is perfect.—Nat. Drug.

To Prevent Screws from Rusting and Becoming Fast.—Screws will sometimes rust in their seats, even when carefully oiled before driving them to their seats, but if they are anointed with a mixture of graphite and soft tallow they will remain unrusted and unaltered for years.—Nat. Drug.

The Barrel Family.—In early times liquids were stored or carried about (as they are still to some extent on the Continent) in skins, and huge jars were made to hold wine and oil. But with the progress of invention and commerce, the serons or skin bales and the wine bags have given place to casks, as more convenient and durable in transport, and the trade of the coopers is now an important one in most places, although its efficiency and prosperity largely depend on the supply of suitable woods and improved machinery.

There is a progressive variety of casks, from the small anker or the little oyster barrel to firkins, kilderkins, hogsheads, pipes, puncheons, tierces, butts and tuns.

By 43 Geo. III, c. 691, 36 gallons of beer were taken to be the measure for a barrel, and all other casks are mostly either parts or multiples of this standard; for example:

A firkin is	¼	containing	9 gallons
A kilderkin is	½	"	18 gallons
A barrel is	1	"	36 gallons
A hogshead is	1½	"	54 gallons
A puncheon is	2	"	72 gallons
A pipe or butt is	3	"	108 gallons
A tun is	6	"	216 gallons

These sizes, however, are not strictly followed. The barrels made in Ireland are of less dimensions than those made in London, and a puncheon of whisky in Scotland usually contains 120 gallons. The tun, as a "wine measure," is assumed to contain 252 gallons, two butts of 126 gallons, or four hogsheads of 63 gallons. But imperial measures have superseded these old denominations.

Foreign made casks are of all descriptions. For instance, a hogshead of claret generally contains from 46 to 50 gallons, and a butt of sherry 108 to 120 gallons; the pipe is 114 gallons; the octave is 11½ gallons, and there is also a half octave. In Germany wine is shipped in aums or ohms of 30 gallons. The casks for storing wine there are larger than those in France, and are called stucks of 240 gallons and half-stucks.

The anker is a small cask or rundlet, containing formerly in this country 8 1-3 gallons. Although now obsolete here, the anker is still a common liquid measure in many of the Continental States, varying from 7½ to 10 gallons.—American Carbonator and Bottler.

To Fix Magnetic Curves of Iron Filings.—One of the experiments made in every physical laboratory in teaching the elements of magnetism and electricity is the production of the magnetic curves by sprinkling iron filings over a glass plate, after the well-known method.

La Lumière Electrique gives a description of a device suggested by M. Korobow, for fixing these curves so that they can be preserved indefinitely. The process is as follows: A plate of glass is warmed on the smooth upper surface of a shallow iron chest containing water raised to a suitable temperature by means of a spirit-lamp. A piece of paraffin is placed on the glass, and in the course of three or four minutes spreads itself evenly in a thin layer over the surface. The glass plate is removed, the surplus paraffin running off. The image is formed with iron filings on the cooled paraffin, which does not adhere to the iron, so that, if the image is unsatisfactory, the filings may be removed and a new figure taken. To fix the curves, the plate of glass is again placed on the warming stove. Finally the surface of the paraffin is covered with white paint, so that the curves appear black on a white ground. Very well-defined figures may thus be obtained. A similar, though much simpler process, consists in covering one surface of stiff white paper with a layer of paraffin, by warming over an iron plate, spreading the filings over the cooled surface, and fixing them with a hot iron or a gas flame.—National Druggist.

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